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RESPONSE OF WEST LAKE QUARRY AND MATERIAL COMPANY

TO

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VOLUME III OF IV

JULY 18, 1991

Ref. 1

NUREG-1308
Rev. 1

Radioactive Material in the West Lake Landfill

Summary Report

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

WQM 0011

Exhibit 14-D

NUREG-1308
Rev. 1

Radioactive Material in the West Lake Landfill

Summary Report

Manuscript Completed: February 1988
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Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ABSTRACT

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris.

This report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from the processing of uranium ores and the subsequent sale by the AEC of processing residues. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is called for.

CONTENTS

1 INTRODUCTION AND BACKGROUND

This report summarizes the circumstances of the radioactive material in the West Lake Landfill (Figure 1), in particular, the radiological environmental aspects as they relate to potential disposition of the material.

The West Lake Landfill, Inc. property is a 200 acre tract in Bridgeton, St. Louis County, Missouri, on the outskirts of the city of St. Louis. It is about 4 miles west of St. Louis' Lambert Field International Airport, near the intersection of interstate highways I-70 and I-270. Limestone was quarried there from 1939 to 1987. Also on the property is an industrial complex where concrete ingredients are measured and combined, and where asphalt aggregate is prepared. Since 1962, portions of the property have been used as landfills for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. In 1973, soil contaminated with radioactive material was placed in a landfill there.

The radioactive material originated with uranium-ore-processing residues which had been stored at Lambert Airport by the U.S. Atomic Energy Commission (AEC), and which were sold in early 1966 to the Continental Mining and Milling Company, of Chicago, Illinois. The AEC's invitation to bid listed the following residues for purchase: 74,000 tons of Belgian Congo pitchblende raffinate containing about 113 tons of uranium; 32,500 tons of Colorado raffinate containing about 48 tons of uranium; and 8700 tons of leached barium sulfate containing about 7 tons of uranium. The material was moved from the airport during 1966 to nearby 9200 Latty Avenue, Hazelwood, Missouri. In January 1967, the Commercial Discount Corporation of Chicago took possession of the residues to remove moisture and to ship the residues to the Cotter Corporation facilities in Canon City, Colorado. In December 1969, the remaining material was sold to the Cotter Corporation. In the following four years, the residues, with the principal exception of the 8700 tons of leached barium sulfate, were shipped to Canon City.[1]

In April 1974, Region III representatives of NRC's Office of Inspection and Enforcement visited the Cotter Corporation's Latty Avenue site to check on the progress of the decommissioning activities being performed there. This inspection disclosed that in 1973 Cotter Corporation had disposed of approximately 8700 tons of leached barium sulfate residues mixed with 39,000 tons of top soil at a local landfill.[1]

By letter dated June 2, 1976, the Missouri Department of Natural Resources (MDNR) forwarded to the NRC's Region III office newspaper articles which alleged that only 9000 tons of waste had been moved from the Latty Avenue site rather than 40,000 tons and that it was moved to the West Lake Landfill rather than to the St. Louis Landfill No. 1. Region III personnel investigated the allegations and found that 43,000 tons of waste and soil had been removed from the Latty Avenue site and had been dumped at the West Lake Landfill in Bridgeton, and that the waste was covered with only about 3 feet of soil.[1]

Discussion with the West Lake Landfill operators indicated that all of the material from Latty Avenue had been disposed of in one area; however, an aerial

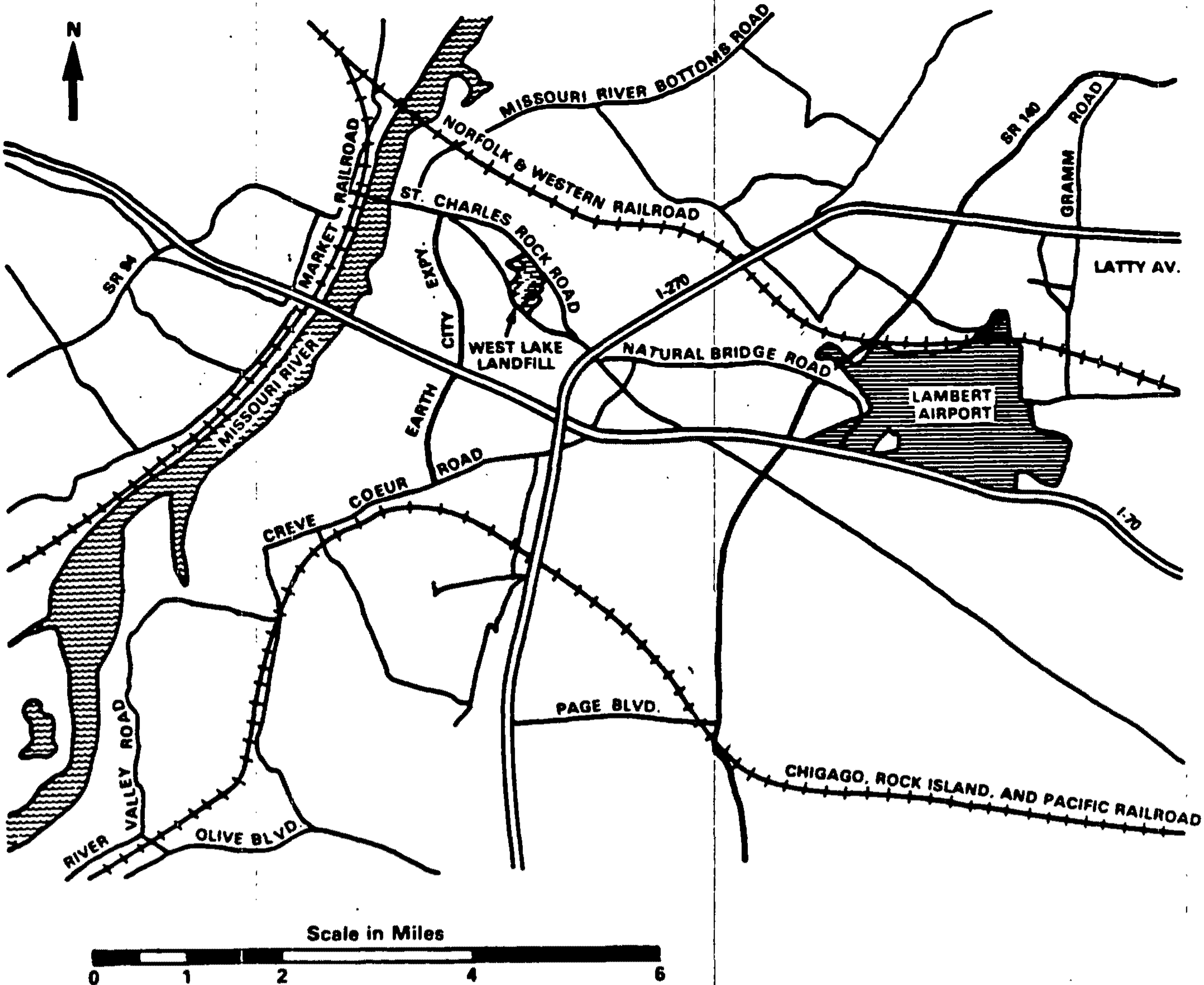

Figure 1 Location of West Lake Landfill

survey of the site identified two areas of contamination. The second contaminated area is identified as Area 1 in Figure 2.[2] Subsequently, the NRC sponsored other studies that were directed at determining the radiological status of the landfill. An extensive survey was initiated in November 1980 by the Radiation Management Corporation (RMC) under contract to the NRC. The findings were published in May 1982 in NUREG/CR-2722, "Radiological Survey of the West Lake Landfill, St. Louis County, Missouri."[3] In March 1983, the NRC through Oak Ridge Associated Universities (ORAU) contracted with the University of Missouri-Columbia (UMC), Department of Civil Engineering, to describe the environmental characteristics of the site, conduct an engineering evaluation, and propose possible remedial measures for dealing with the radioactive waste at the West Lake Landfill. In May 1986, ORAU sampled water from wells on and close to the landfill to determine if the radioactive material had migrated into the groundwater. A report is being prepared detailing the results of the investigations conducted by UMC and ORAU.[2]

Information from all these sources and from NRC site visits forms the basis for this report.

2 DESCRIPTION OF THE SITE

Location

The 200-acre West Lake Landfill site is situated on the southwest side of St. Charles Rock Road in Bridgeton, St. Louis County, Missouri (Figure 1).[2] It is about 16 miles northwest of the downtown area of the city of St. Louis, and about 4 miles west of Lambert Field International Airport (Figure 1). It is approximately 1.2 miles from the Missouri River.

History

The West Lake Landfill has been used since 1962 for the disposal of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. Between 1939 and the spring of 1987, limestone was quarried there. Landfill operations filled in some of the excavated pits from the quarry operations. Also on the property is an active industrial complex in which concrete ingredients are measured and combined before mixing ("batching"), and asphalt aggregate is prepared.

The unregulated landfill, in which the radioactive material was placed in 1973, was closed in 1974 by the Missouri Department of Natural Resources (MDNR). Also in 1974, under an MDNR permit, a newer sanitary landfill was opened and now operates in an adjacent area on the West Lake Landfill property. The newer landfill is protected from groundwater contact. The bottom of the new landfill is lined with clay, and a leachate collection system has been installed. Leachate is pumped to a treatment system consisting of a lime precipitation unit followed in series by an aerated lagoon and two unaerated lagoons. The final lagoon effluent is discharged into St. Louis Metropolitan Sewer District sewers.[2]

Ownership

Since 1939, the West Lake Landfill has been owned by West Lake Landfill, Inc., of 13570 St. Charles Rock Road, Bridgeton, Missouri.

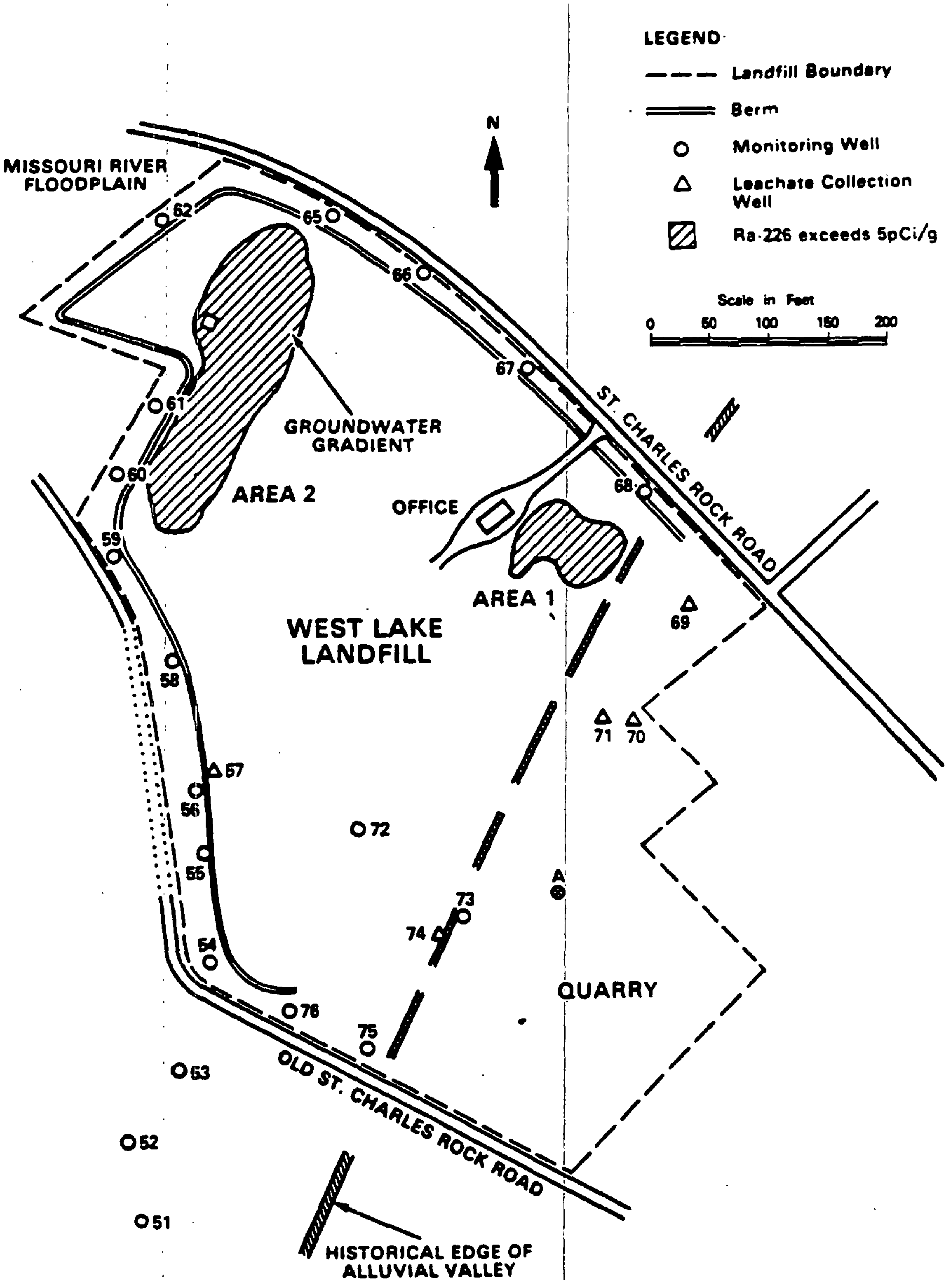

Figure 2 Site Details

Contaminated Areas

Radioactive contamination at the West Lake Landfill has been identified in two separate soil bodies (Figure 2).

The northern area (referred to as Area 2) covers about 13 acres[3] and lies above 16 to 20 feet of landfill debris. The contaminated soil forms a more or less continuous layer from 2 to 15 feet in thickness and consists of approximately 130,000 cubic yards of soil. Some of this contaminated soil is near or at the surface, particularly along the face of the northwestern berm. Beneath the landfill debris, the soil profile consists of 3 to 7 feet of floodplain top soil overlying 30 to 50 feet of sand and gravel alluvium.

The southern area of contamination (Area 1) covers about 3 acres[3] and contains roughly 20,000 cubic yards of contaminated soil. This body of soil is located east of the landfill's main office at a depth of about 3 to 5 feet and is located over a former quarry pit which was filled in with debris. The depth of debris beneath the contaminated soil is unknown but is estimated to be 50 to 65 feet. Limestone bedrock underlies the landfill debris.[2]

Topography

About 75 percent of the landfill site is located on the floodplain of the Missouri River (Figure 2) at about 440 feet above mean sea level (msl). The site topography is subject to change because of the types of activities (e.g., landfilling and quarrying) performed there. However, the areas containing the radioactive waste have their surface at about 470 feet (msl). The surface runoff in the area around the landfill follows several surface drains and ditches that run in a northwest direction and drain into the Missouri River.[2]

Geology

Bedrock beneath the West Lake Landfill consists of limestone that extends downward to an elevation of 190 feet msl. The limestone is dense, bedded, and except for intermittent layers that consist of abundant chert nodules, fairly pure. The Warsaw Formation, which lies directly beneath the limestone, is made up of approximately 40 feet of slightly calcareous, dense shale; this grades into shaley limestone toward the middle of the formation. Bedrock beneath the site dips at an angle of 0.5° to the northeast. Five miles east of the site, the attitude of the bedrock is reversed by the Florissant Dome.[2]

Since groundwater moving through carbonate rocks often creates channels for rapid water flow, the possibility of this occurring in the West Lake Landfill area was considered. Brief observation of the quarry walls at the landfill suggests that some of the limestone has dissolved. In a letter to West Lake Landfill, Inc., the Missouri Department of Natural Resources stated that the fact that grouting was necessary in the quarry area to block water inflow suggests that the limestone is at least somewhat solution weathered.[4] However, in the draft UMC report, the opinion is expressed that the solution activity has apparently been limited to minor widening of joints and bedding planes near the bedrock surface, and that, at depth and when undisturbed, the limestone is fairly impervious.[2] It is not clear whether the views represented by these statements are in conflict.

Soil material in the area may be divided into two categories: Missouri River alluvium and upland loessal soil. This demarcation is shown as the historical edge of the alluvial valley in Figure 2. The division is made on the basis of soil composition, depositional history, and physical properties. The West Lake Landfill lies over this transition zone.[2]

Hydrology

Groundwater flows in the area surrounding the West Lake site through two aquifers: the Missouri River alluvium and the shallow limestone bedrock. Although the limestone is fairly impervious and groundwater flows in most areas from the bedrock into the alluvium, contamination of water in the bedrock aquifer is possible. The base of the limestone aquifer is formed by the relatively impermeable Warsaw shale at an elevation of about 190 feet (msl). This shale layer has been reached, but not disturbed, by quarrying operations. Therefore, the Warsaw shale acts as an aquiclude, making contamination of the deeper limestone unlikely.

The deep Missouri River alluvium, which is under about 10 feet of more-recent alluvium, acts as a single aquifer of very high permeability. This aquifer is relatively homogeneous in a downstream direction and decreases in permeability near the valley walls.

The water table of the Missouri River floodplain is generally within 10 feet of the ground surface, but at many points it is even shallower. At any one time, the water levels and flow directions are influenced by both the river stage and the amount of water entering the floodplain from adjacent upland areas.

Water levels recorded between November 1983 and March 1984 in monitoring wells at the landfill, indicate a groundwater gradient of 0.005 flowing in a N 30°W direction beneath the northern portion of the landfill. This represents the likely direction of leachate migration from the landfill.

Since no other recharge sources exist above the level of the floodplain, the only water available to leach the landfill debris is that resulting from rainfall infiltrating the landfill surface. Because the underlying alluvial aquifer is highly permeable, there will be little "mounding" of water beneath the landfill. Also, the northern portion of the landfill has a level surface, and thus it is likely that at least half of the rainfall infiltrates the surface. The remaining rainfall is lost to evapotranspiration and (to a lesser degree) surface runoff.[2]

No public water supplies are drawn from the alluvial aquifer near the West Lake Landfill. It is believed that only one private well in the vicinity of the landfill is used as a drinking-water supply. This well is 1.4 miles N 35°W of the Butler-type building on the West Lake Landfill.

Because of the extremely low slope of the Missouri River floodplain surface, rain falling on the plain itself generally infiltrates the soil rather than running off the surface. The only streams present on the floodplain are those that originate in upland areas. Drainage patterns on the plain have been radically altered by flood control measures taken to protect Earth City and by drainage of swamps and marshes. Because of the relationship that exists between river level and groundwater level in portions of the floodplain near the river, streams may either lose flow (at low stage) or gain flow (at high stage).

The present channel of the Missouri River lies just under 2 miles west and northwest of the landfill. The Missouri River stage at St. Charles (mile 28) is zero for a water level of 413.7 feet (msl). Average discharge of the Missouri River is 77,338 cubic feet per second.

Water supplies are drawn from the Missouri River at mile 29 for the city of St. Charles, and the intake is located on the north bank of the river. Another intake at mile 20.5 is for the St. Louis Water Company's North County plant. The city of St. Louis takes water from the Mississippi River, which is joined by the Missouri River downstream from the landfill. The intake structures for St. Louis are on the east bank of the river, so that the water drawn is derived from the upper Mississippi.[2]

Demography

Two small residential communities are present near the West Lake Landfill: Spanish Lake Village consists of about 90 homes and is located 0.9 mile south of the landfill, and a small trailer court lies across St. Charles Rock Road, 0.9 mile southeast of the site. Subdivisions are presently being developed 1 to 2 miles east and southeast of the landfill in the hills above the floodplain. Ten or more houses lie east of the landfill, scattered along Taussig Road. The city of St. Charles is located north of the Missouri River, more than 2 miles from the landfill.[2]

Population density on the floodplain is generally less than 26 persons per square mile, but the daytime population (including factory workers) is much greater than the number of full-time residents. Earth City Industrial Park is located on the floodplain 0.9 to 1.2 miles northwest of the landfill. The Ralston-Purina facilities are located 0.2 mile northeast of the Butler-type building at the landfill. Considering that land in this area is relatively inexpensive and that much of it is zoned for manufacturing, industrial development on the floodplain will likely increase.[2]

3 RADIOLOGICAL SURVEYS

From August 1980 through the summer of 1981, the Radiation Management Corporation (RMC), under contract to the NRC, performed an onsite evaluation of the West Lake Landfill[3] to define the radiological conditions at the landfill. The results were utilized in performing this determination regarding whether or not remedial actions should be taken.

The area to be surveyed was divided into 33-foot grid blocks and included the following measurements:

(1) external gamma exposure rates 3.3 feet above the ground surface and beta-gamma count rates 0.4 inch above the surface;

(2) radionuclide concentrations in surface soils;

(3) radionuclide concentrations in subsurface deposits;

(4) total ("gross") activity and radionuclide concentrations in surface and subsurface water samples;

(5) radon flux emanating from surfaces;

(6) airborne radioactivity; and

(7) total activity in vegetation.

External Gamma

The two areas of elevated external (gamma) radiation levels, as they existed in November 1980 at the time of the preliminary RMC site survey, both contained places where levels exceeded 100 μR per hour at 3.3 feet. In Area 2, gamma levels as high as 3000 to 4000 μR per hour were detected. The total areas exceeding 20 μR per hour were about 2 acres in Area 1 and 9 acres in Area 2.[3] (The criterion of 20 μR per hour is derived from the NRC's Branch Technical Position, 46 FR 52061, October 23, 1981, which aims at exposure rates less than 10 μR per hour above background levels; background radiation was taken to be 10 μR per hour also.)

External gamma levels were measured in May and July of 1981. These levels were significantly smaller than the November 1980 values, especially in Area 1, because approximately 4 feet of sanitary fill had been added to the entire area, and an equal amount of construction fill was added to most of Area 2. As a result, only a few thousand square feet in Area 1 exceed 20 μR per hour. In Area 2, the total area exceeding 20 μR per hour decreased by about 10 percent, and the highest levels were about 1600 μR per hour near the Butler-type building.[3]

Surface Soil Analysis

A total of 61 surface soil samples were gathered and analyzed on site for gamma activity. Concentrations of U-238, Ra-226, Ra-223, Pb-211, and Pb-212 were determined for each sample. In all soil samples, only uranium and/or thorium decay chain nuclides and K-40 were detected. Offsite background samples were on the order of 2 pCi per gram for Ra-226. Onsite samples ranged from about 1 to 21,000 pCi Ra-226 per gram and from less than 10 to 2100 pCi U-238 per gram. In samples in which elevated levels of Ra-226 were detected, the concentrations of U-238 were generally one-half to one-tenth of those of Ra-226. In cases of elevated sample activity, daughter products of both U-238 and U-235 were found.[3]

In general, surface activity was limited to Area 2, as indicated by the surface beta-gamma measurements. Only two small regions in Area 1 showed surface contamination; both were near the access road across from the site offices.

In addition to onsite gamma analyses, 12 samples were submitted to RMC's radiochemical laboratories for thorium and uranium radiochemical determinations. The results of these measurements (Table 4 of NUREG/CR-2722) show that all samples contained high levels of Th-230. The ratio of Th-230 to Ra-226 (inferred from Bi-214) generally ranges from 4:1 to 40:1.

Subsurface Soil Analysis

Subsurface contamination was assessed by extensive "logging" of holes drilled through the landfill. Several holes were drilled in areas known to contain contamination, then additional holes were drilled at intervals in all directions until no further contamination was detected. A total of 43 holes were drilled (11 in Area 1 and 32 in Area 2), including 2 offsite wells for monitoring water. All holes were drilled with a 6-inch auger and were lined with 4-inch PVC (polyvinyl chloride) casing.[3]

Each hole was scanned with a 2-inch NaI(Tl) detector and rate meter system for an initial indication of the location of subsurface contamination. On the basis of the initial scans, 19 holes were selected for detailed gamma logging using the intrinsic germanium (IG) detector and multiple channel analyzer. Concentrations of Ra-226, as determined by the IG system, ranged from less than 1 pCi per gram to 22,000 pCi per gram.[3]

It was determined that the subsurface deposits extended beyond areas in which surface radiation measurements exceeded the reference level of 20 μR per hour. The lateral extent of material exceeding 5 pCi Ra-226 per gram, including both surface and buried materials, is shown on Figure 2. The total difference in areas is about 5 acres.

The surface elevations vary by about 20 feet, and the highest elevations occur at locations of more recent fill. Contaminated soil (>5 pCi Ra-226 per gram) is found from the surface to depths as great as 20 feet below the surface. In general, the contamination appears to be a continuous single layer ranging from 2 to 15 feet thick and covering 16 acres.[3]

Nonradiological Analysis

Six composite samples were submitted to RMC's Environmental Chemistry Laboratory for priority pollutant analysis. Five samples were taken from auger holes (one from Area 1 and four from Area 2) and the sixth was taken from sludge from the West Lake Landfill leachate treatment plant. The analysis shows organic solvents present in the Area 2 samples. Positive results were reported for 25 listed organic compounds. Chromium, copper, lead, nickel, and zinc were the predominant elemental priority pollutants detected. The analysis of the sample from the leachate treatment sludge showed that it had smaller pollutant concentrations than the samples from the auger holes.[3]

Chemical analyses of material from the radioactive layer from both areas were also performed by RMC's laboratory. In most cases, elevated levels of barium and lead were found.

Background Radioactivity Measurement

Several offsite locations (within a few miles of the West Lake Landfill) were selected for reference background measurements. Background values were all within the normal range. The gamma exposure rates were 8 and 10.6 μR per hour. Radium-226 concentrations in soil were 2.5 and 2.6 pCi per gram. Radon flux from the ground surface was 0.50 and 0.58 pCi per square meter-second; working level values were 0.0011, 0.0017, and 0.005 WL.[3]

Airborne Radioactivity Analysis

Both gaseous and particulate airborne radioactivity were sampled and analyzed during this study. Since it was known that the buried material consisted partially or totally of uranium ore residues, the sampling program concentrated on measuring radon and its daughters in the air. Two methods were used: the first was a scintillation flask (accumulator) method for radon gas, and the second was analysis of filter paper activity for particulate daughters. A series of grab samples using the accumulator method were taken between May and August of 1981. A total of 111 samples from 32 locations were collected. Measurable radon flux levels ranged from 0.2 pCi per square meter-second in low background areas to 865 pCi per square meter-second in areas of surface contamination.[3]

At three locations, measurements were repeated over a period of 2 months. Significant fluctuations were observed at two locations. The fact that these fluctuations were real and not measurement artifacts was later confirmed by duplicate charcoal canister samples.

A set of 10-minute, high-volume, particulate, air samples was taken to determine both short-lived radon daughter concentrations and long-lived gross alpha activity. The highest levels (0.031 WL) were detected in November 1980, near and inside the Butler-type building. These two samples approximately equal NRC's 10 CFR Part 20, Appendix B, alternate concentration limit of one-thirtieth WL for unrestricted areas. In addition to the routine 10-minute samples, five 20-minute, high-volume, air samples were taken and counted immediately on the IG gamma spectroscopy system to detect the presence of Rn-219 daughters. All samples were taken near surface contamination. Concentrations of Rn-219 daughters ranged from 6×10^{-11} to 9×10^{-10} µCi per cubic centimeter.[3]

Vegetation Analysis

Vegetation samples collected by RMC included weed samples from onsite locations and farm crop samples (winter wheat) near the northwest boundary of the landfill. This location was chosen because water could run off from the fill onto the farm field. No elevated activities were found in these samples.[3]

Water Analysis

A total of 37 water samples were taken by RMC and analyzed for gross alpha and beta activity. Four samples were taken in the fall of 1980 and the remainder in the spring and summer of 1981. One sample was equal to the U.S. Environmental Protection Agency (EPA) gross-alpha-activity standard for drinking water of 15 pCi per liter and that was a sample of standing water near the Butler-type building. Several samples, including all the leachate treatment plant samples, exceeded the EPA drinking water action level for gross beta activity. Subsequent isotopic analyses indicated that the beta activity could be attributed to K-40. None of the offsite samples exceeded either EPA standard.[3]

In 1981, the Missouri Department of Natural Resources collected 41 water samples that RMC analyzed for radioactivity. Of these samples, 5 were background, 10 were onsite surface water, 10 were shallow groundwater standing in boreholes, and 16 were landfill leachate. From these data, background activity is estimated as 1.5 pCi gross alpha activity per liter and 30 pCi gross beta activity per liter. One groundwater sample was at 15 pCi gross alpha per liter, and one surface water sample was 45 pCi per liter. Most of the leachate samples were above 50 pCi beta per liter.[3]

In addition, groundwater samples in 11 perimeter monitoring wells at the West Lake Landfill were taken by the Reitz and Jens Engineering firm on November 15, 1983, and by University of Missouri at Columbia (UMC) personnel on March 21, 1984. In both sampling times, one well, but not the same one, exceeded the EPA's drinking water standard of 15 pCi per liter (18.2 pCi per liter in 1983 and 20.5 pCi per liter in 1984). On May 7 and 8, 1986, Oak Ridge Associated Universities (ORAU) personnel took water samples from 44 perimeter wells; only one (by Old St. Charles Rock Road) with 17 pCi alpha activity per liter exceeded the drinking water standard.[2]

The operators of the landfill, West Lake Landfill, Inc., have an ongoing hydrogeologic investigation of the site, which also involves analyses of monitoring well samples for radioactivity and for priority pollutants.[4]

4 ESTIMATION OF RADIOACTIVITY INVENTORY

Soil sample analyses have shown that the radioactive material in Areas 1 and 2 of the landfill consists almost entirely of natural uranium and its radioactive decay products.

The analyses of soil samples indicate that the naturally occurring U-238 to Th-230 to Ra-226 equilibrium has been altered and that the ratio of Ra-226 to U-238 is on the order of 2:1 to 10:1; the ratio of Th-230 to Ra-226 generally ranges from 4:1 to about 40:1. These ratios are in accord with the history of the radionuclide deposits in the West Lake Landfill, i.e., that they came from the processing of uranium ores. The indicator radionuclides for assessment of the radiological impacts of the material are therefore U-238, Th-230, and Ra-226.

Using the RMC data and averaging the auger hole measurements over the volumes of radioactive material found in Areas 1 and 2, a mean concentration of 90 pCi per gram was calculated for Ra-226.[2] For the ratio of Th-230 to Ra-226, the RMC data[3] range from 4:1 to 40:1; data from samples taken in 1984 along the berm range up to almost 70:1.[5] A further consideration is that the material came from Cotter Corporation's Latty Avenue site (later sold to Futura Coatings, Inc.). Measurements at the Latty Avenue site are variously reported as up to 180:1[6] and about 300:1.[7] Some material of that nature might have been transferred along with the barium sulfate residues. To ensure conservatism in estimating the long-term in-growth of Ra-226, the NRC staff used a ratio of 100:1 to estimate the Th-230 activity. Similarly, the Ra-226:U-238 ratio ranges from 2:1 to 10:1. This ratio is less critical to the radiological aspect of the site and has been estimated to be 5:1 for purposes of calculation.

Using the Th-230:Ra-226 ratio of 100:1, the Th-230 activity is 9000 pCi per gram. If the U-238 concentration (as well as U-234 which would be similarly separated from the ore) is a factor of 5 less than Ra-226, this implies about 18 pCi U-238 per gram. The total mass of radioactive material in the landfill was estimated by visually integrating the volume of radioactive material from graphs and multiplying by an average soil density, resulting in 1.5×10^{11} grams (150,000 metric tons) of contaminated soil.

These numbers indicate that there are about 14 Ci of Ra-226 contained with its decay products in the radioactive material in the landfill. The material also contains about 3 Ci each of U-238 and U-234, and about 1400 Ci of Th-230. These estimates indicate the order of magnitude of the quantities to be dealt with, although the estimate for Th-230 is regarded as conservatively large.

5 APPLICABILITY OF THE BRANCH TECHNICAL POSITION

The NRC has established a Branch Technical Position (BTP) which identifies five acceptable options for disposal or onsite storage of wastes containing low levels of uranium and thorium (46 FR 52061, October 23, 1981).[8]

The concentrations permitted under each disposal option are shown in Table 1.

Table 1 Summary of maximum soil concentrations permitted under disposal options

Source: 46 Federal Register 52061

Kind of material	Disposal options 1[a]	2[b]	3[c]	4[d]
Natural thorium (Th-232 + Th-228) with daughters present and in equilibrium. (pCi/g)	10	50	-	500
Natural uranium (U-238 + U-234) with daughters present and in equilibrium. (pCi/g)	10	-	40	200

[a]Based on EPA uranium mill tailings cleanup standards.

[b]Concentrations based on limiting individual doses to 170 mrem per year.

[c]Concentration based on limiting equivalent exposure to 0.02 WL or less.

[d]Concentrations based on limiting individual intruder doses to 500 mrem per year and, in cases of natural uranium, limiting exposure to Rn-222 and other airborne alpha emitters to 0.02 WL or less.

Options 1-4 provide methods under 10 CFR 20.302, for onsite disposal of slightly contaminated materials, e.g., soil, if the concentrations of radioactivity are small enough and other circumstances are satisfactory. The fifth option consists of onsite storage pending availability of an appropriate disposal method.

The material present in the West Lake Landfill is a form of natural uranium with daughters, although the daughters are not now in equilibrium. As mentioned in

Section 4, the average concentration of Ra-226 in the West Lake Landfill wastes is about 90 pCi per gram, which (considered by itself) falls into Option 4 of the BTP since Option 4 criteria are controlled by the Ra-226 content in the wastes (i.e., 200 pCi of U-238 plus U-234 per gram would be accompanied by 100 pCi of Ra-226 per gram). However, because of the large ratio of Th-230 radioactivity to that of Ra-226, the radioactive decay of the Th-230 will increase the concentration of its decay product Ra-226 until these two radionuclides are again in equilibrium. Assuming the ratio of activities of 100:1 used above, the Ra-226 activity will increase by a factor of five over the next 100 years, by a factor of nine 200 years from now, and by a factor of thirty-five 1000 years from now. All radionuclides in the decay chain after Ra-226 (and thus the Rn-222 gas flux) will also be increased by similar multiples. Therefore, the long-term Ra-226 concentration will exceed the Option 4 criteria. Under these conditions, onsite disposal, if possible, will likely require moving the material to a carefully designed and constructed "disposal cell."

6 REMEDIAL ACTION ALTERNATIVES EXAMINED

The evaluation performed by staff of the University of Missouri at Columbia addresses six potential remedial action alternatives, including that of leaving the radioactive material as it is, designated Option A.[2] Option D is the option of excavating the material and shipping it to another site for disposal. Options B, C, E, and F address different approaches to stabilizing the material on the West Lake Landfill site, primarily as temporary remedial actions. Options B, C, and F leave most of the radioactive material where it is but include a variety of measures to contain it and its radon releases and gamma emissions. Option E addresses the approach of constructing an onsite earthen cell, similar to a disposal cell, and moving the radioactive material into it. Under Option F, the radioactive material would be left in place and separate slurry walls would be built downgradient of Areas 1 and 2 to constrain groundwater motion. The estimated costs of Options B through F range from about $370,000 (Option B) to about $5,500,000 (Option F) in 1984 dollars. The estimate for Option D is about $2,500,000, but this does not include the cost of transporting the material to another site and disposing of it there; in the staff's judgment, this could increase the cost by as much as a factor of ten.

Further studies are necessary to determine the most practical approach to disposal of this material.

7 FACTORS CONTRIBUTING UNCERTAINTY

The presence in the landfill of other substances listed as hazardous by the U.S. Environmental Protection Agency raises issues of whether the waste is mixed waste (i.e., both radioactive and chemically hazardous), and whether the landfill must also be disturbed to provide for proper containment of the chemical wastes.

The manner of placing the 43,000 tons of contaminated soil in the landfill caused it to be mixed with additional soil and other material, so that now an appreciably larger amount is involved. If it must be moved, it is not certain whether the amount requiring disposal elsewhere is as little as 60,000 tons or even more than 150,000 tons.

Because the controlling radionuclide (Th-230) has no characteristics that make it easy to measure quantitatively in place, as can be done for the Ra-226 with its decay products, the large but variable ratio of Th-230 to Ra-226 and its decay products makes the delineation of cleanup more difficult. When the ratio is so large (20:1 or more), even a small concentration of Ra-226 in 1988 implies such a large concentration later that it will be necessary to employ more difficult measurement techniques to confirm that the cleanup has been satisfactory.

Any possibility of disposal on site will depend on adequate isolation of the waste from the environment, especially for protection of the groundwater. It is unclear whether the area's groundwater can be protected from onsite disposal at a reasonable cost. This matter will require additional investigation.

8 SUMMARY

In 1973, radioactively contaminated soil amounting to approximately 43,000 tons was deposited in the West Lake Landfill near St. Louis, Missouri. The material originated with decontamination efforts at the Cotter Corporation's Latty Avenue plant. Disposal in the West Lake Landfill was not authorized by the NRC. State officials were not notified of this disposal in 1973 because the landfill was not regulated by the State at the time.

In the period 1980-1981, Radiation Management Corporation (RMC) of Chicago, Illinois, under contract to the NRC, performed a detailed radiological survey of the West Lake Landfill. This survey showed that the radioactive contaminants are in two areas. The northern area (Area 2) covers about 13 acres. The radioactive debris forms a layer 2 to 15 feet thick, exposed in only a small area on the landfill surface and along the berm on the northwest face of the landfill. The southern area (Area 1) contains a relatively minor fraction of the debris covering approximately 3 acres with most of the contaminated soil buried with about 3 feet of clean soil and sanitary fill.

The RMC survey showed that the radioactivity is from the naturally occurring U-238 and U-235 series with Th-230 and Ra-226 as the radionuclides that dominate radiological impact. The survey data indicate that the average Ra-226 concentration in the radioactive wastes is about 90 pCi per gram; the staff estimates the average Th-230 concentration to be about 9000 pCi per gram. Since Ra-226 has been depleted with respect to its parent Th-230, Ra-226 activity will increase in time (for example, over the next 200 years, Ra-226 activity will increase ninefold over the present level). This increase in Ra-226 must be considered in evaluating the long-term hazard posed by this radioactive material.

In addition to RMC's radiological survey, soil and water samples were collected and analyzed by others, including ORAU, UMC, and MDNR. Occasionally a sample of water from a monitoring well exceeds slightly the EPA drinking water standard of 15 pCi gross alpha per liter. Sample analyses for priority pollutants (nonradioactive hazardous substances) show a number of listed pollutants are present. The landfill operators are also conducting a hydrogeological investigation.

From the RMC, UMC, and ORAU surveys conducted at the West Lake Landfill site the staff has made the following findings:

(1) There is a large quantity (on the order of 150,000 tons) of soil contaminated with long-lived radioactive material in the West Lake Landfill. Almost all the radioactivity consists of natural uranium and its radioactive decay products.[3]

(2) Based on the radiological surveys, the radioactive wastes as presently stored at the West Lake Landfill do not satisfy the conditions for Options 1-4 of the NRC's Branch Technical Position (BTP) regarding the disposal of radioactive wastes containing uranium or thorium residues.[8]

(3) A dominant factor for the future is that the average activity concentration of Th-230 is much larger than that of its decay product Ra-226, indicating a significant increase in the radiological hazards in the years and centuries to come.

(4) Some of the radioactive material on the northwestern face of the berm has no protective cover of soil to prevent the spread of contamination and attenuate radiation.

(5) Slightly more than 8 acres of the site exceed 20 μR per hour; the highest reading of 1600 μR per hour occurs near the Butler-type building.

(6) Radon and daughters were measured at 0.031 WL in and around the Butler-type building. This exceeds the BTP value of 0.02 WL.

(7) Based on monitoring-well sample analyses, some low-level contamination of the groundwater is occurring, indicating that the groundwater in the vicinity is not adequately protected by the present disposition of the wastes.

(8) Although these radiological conditions indicate that remedial action is needed, it is unlikely that anyone has received significant radiation exposures from the existing situation.

(9) Sampling results show that chemically hazardous materials have been disposed of adjacent to or possibly mixed with the radioactive material.[3] It is possible that part of the radioactive material has become "mixed" waste.

From these findings and the information developed to date, the NRC staff concludes: (1) measures must be taken to establish adequate permanent control of the radioactive waste and to mitigate the potential long-term adverse impacts from its existing temporary storage conditions and (2) the information developed to date is inadequate for a technological determination of several important issues, i.e., whether mixed wastes are involved, and whether onsite disposal is practical technologically, and, if so, under what alternative methods.

As indicated by the estimates developed by UMC, remedial action will be costly. Further, the investigations to develop the necessary information to resolve major questions and to provide a sound basis for evaluation of the feasibility of disposal alternatives may also be costly. Therefore, it is necessary to determine the way to accomplish the further studies and remedial actions that are needed.

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13. ABSTRACT (200 words or less)

The West Lake Landfill is located near the city of St. Louis in Bridgeton, St. Louis County, Missouri. The site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. This report summarizes the circumstances of the radioactive material in the West Lake Landfill. The radioactive material resulted from the processing of uranium ores and the subsequent sale by the Atomic Energy Commission of the processing residues. Primary emphasis is on the radiological environmental aspects as they relate to potential disposition of the material. It is concluded that remedial action is called for.

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SITE CHARACTERIZATION AND
REMEDIAL ACTION CONCEPTS FOR
THE WEST LAKE LANDFILL

Docket No. 40-8801

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U.S. Nuclear Regulatory Commission
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Exhibit 14-E

PREFACE

This report has as its basis a characterization of the West Lake Landfill site and evaluation of some potential remedial measures performed primarily by S. K. Banerji, W. H. Miller, J. T. O'Connor and L. S. Uhazy of the University of Missouri-Columbia. The Nuclear Regulatory Commission received the first and second drafts, then titled "Engineering Evaluation of Options for Disposition of Radioactively Contaminated Residues Presently in the West Lake Landfill, St. Louis County, Missouri," in 1984; thus most of the information in this report dates from 1983-1984. However, some more recent data, principally water sampling results, have been added. Waste disposal and other industrial activities have continued on the 200 acre site, as have activities in the vicinity, resulting in changes in details of topography, roads, etc. To provide a more complete view of the radioactive material in the landfill, use has been made of figures from the report titled "Radiological Survey of the West Lake Landfill, St. Louis County, Missouri," NUREG/CR-2722, May 1982.

The remedial action concepts in this report are those proposed by the contractor. Judgments expressed in this report about these concepts are in general those of the contractor, and do not necessarily represent the views of the Nuclear Regulatory Commission. For example, the cost estimates for these concepts are based on radium-226 concentrations whereas the long-term issue is dependent upon the thorium-230 concentrations.

Although some of its information has not been updated since 1984, this report is being released so as to make its collected information available to interested parties.

ABSTRACT

The West Lake Landfill is near the city of St. Louis in Bridgeton, St. Louis County, Missouri. In addition to municipal refuse, industrial wastes and demolition debris, about 43,000 tons of soil contaminated with uranium and its radioactive decay products were placed there in 1973. After learning of the radioactive material in the landfill, the U.S. Nuclear Regulatory Commission (NRC) had a survey of the site's radioactivity performed and, in 1983, contracted, through Oak Ridge Associated Universities (ORAU), with the University of Missouri-Columbia (UMC) to characterize the environment of the site, conduct an engineering evaluation, and propose remedial measures. This report presents a description of the results of the UMC work, providing the environmental characteristics of the site, the extent and characteristics of the radioactive material there, some considerations with regard to potential disposal of the material, and some concepts for remedial measures.

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CONTENTS (Continued)

TABLES (Continued)

SUMMARY

In 1973, approximately 7900 metric tons (mt) (8700 short tons) of radioactively contaminated barium sulfate ($BaSO_4$) residues were mixed with about 35,000 mt (39,000 t) of soil, and the entire volume was placed in the West Lake Landfill in St. Louis County, Missouri. This material resulted from decontamination efforts at the Cotter Corporation's Latty Avenue plant where the material had been stored. Disposal in the West Lake Landfill was not authorized by the Nuclear Regulatory Commission (NRC) and was contrary to the disposal location indicated in the NRC records. State officials were not notified of this disposal since the landfill was not regulated by the State at the time. Although the contamination does not present an immediate health hazard, authorities have been concerned about whether this material poses a long-term health hazard to workers and residents of the area and what, if any, remedial action is necessary.

In 1980-81, Radiation Management Corporation (RMC) of Chicago, Illinois, performed a detailed radiological survey of the West Lake Landfill under contract to the NRC (NUREG/CR-2722). This survey was performed to determine the extent of radiological contamination. Before this survey, little was known about the location or activity of radionuclide-bearing soils in the landfill. * This survey showed that the radioactive contaminants are in two areas. The * northern area (Area 2) covers about 13 acres. The radioactive debris forms a layer 2 to 15 feet thick, exposed in only a small area on the landfill surface and along the berm on the northwest face of the landfill. The southern area (Area 1) contains a relatively minor fraction of the debris covering approximately 3 acres with most of the contaminated soil buried with about 3 feet of clean soil and sanitary fill.

The RMC survey showed that the radioactivity is from the naturally occurring U-238 and U-235 series with Th-230 and Ra-226 as the radionuclides that dominate radiological impact. The survey data indicate that the average Ra-226 concentration in the radioactive wastes is about 90 pCi per gram; the average Th-230

concentration is estimated to be about 9000 pCi per gram. Since Ra-226 has been depleted with respect to its parent Th-230, Ra-226 activity will increase in time (for example, over the next 200 years, Ra-226 activity will increase ninefold over the present level). This increase in Ra-226 must be considered in evaluating the long-term hazard posed by this radioactive material.

In addition to RMC's radiological survey, soil and water samples were collected and analyzed by others, including Oak Ridge Associated Universities (ORAU), and the University of Missouri-Columbia (UMC). Occasionally a sample of water from a monitoring well exceeds slightly the EPA drinking water standard of 15 pCi gross alpha per liter. Sample analyses for priority pollutants (non-radioactive hazardous substances) show a number of listed pollutants are present.

On the basis of radiological surveillance conducted by RMC, UMC, and ORAU, the following areas of concern have been identified:

(1) Radioactive soil is eroding from the northwestern face of the berm, and is being transported off site.

(2) Radon gas had been observed to accumulate to an unacceptable level in the Butler-type building on site. This building has since been removed.

(3) Some degree of radiological contamination has been found in the wells that monitor the perimeter.

(4) Surface exposure rates over much of the contaminated areas are greater than 20 μR/hr.

In March 1983, the NRC through ORAU, contracted with UMC to conduct an engineering evaluation of the site and propose possible remedial measures for NRC's consideration for dealing with the radioactive waste at the West Lake Landfill. The following six remedial options were proposed and evaluated in this study.

- Option A - No remedial action
- Option B - Stabilization onsite with restricted land use

- Option C - Extending the landfill offsite with restricted land use
- Option D - Removal and relocation of the contaminated material to an authorized disposal site
- Option E - Excavation and temporary onsite storage in a trench
- Option F - Construction of a slurry wall to prevent leachate from migrating off site

It is noted that some of the above alternatives for remedial action were initially evaluated with the objective of permanent disposal of the waste at the site.

1 INTRODUCTION

The West Lake Landfill is located in St. Louis County, Missouri, 6 km (3.7 miles) west of Lambert Field International Airport (Figure 1.1) and southwest of St. Charles Rock Road in Bridgeton, Missouri. The site has been used since 1962 for disposing of municipal refuse, industrial solid and liquid wastes, and construction demolition debris. In addition, the landfill is an active industrial complex on which concrete ingredients are measured and combined before mixing ("batching"), and asphalt aggregate is prepared. Limestone ceased to be quarried in the spring of 1987.

In 1973, 7900 metric tons [(mt) (8700 short tons)] of radioactively contaminated barium sulfate ($BaSO_4$) residues from uranium and radium processing were mixed with an estimated 35,000 mt (39,000 tons) of soil and deposited in the West Lake Landfill. Previously, this material was located at the Cotter Corporation's Latty Avenue facility in Hazelwood, Missouri, and was removed during decontamination work. It is not known what levels of contamination were already in the soil before the barium sulfate residues were mixed into it. Disposal in the West Lake Landfill was unauthorized and contrary to the disposal location indicated in the U.S. Nuclear Regulatory Commission's (NRC's) records.

Subsequently, the NRC sponsored studies that were directed at determining the radiological status of the landfill. In 1978, an aerial radiological survey revealed two areas within the landfill where the gamma radiation levels indicated radioactive material had been deposited. A more extensive survey was initiated in November 1980 by the Radiation Management Corporation (RMC) under contract to the NRC.

In March 1983, the NRC through Oak Ridge Associated Universities (ORAU) contracted with the University of Missouri-Columbia Department of Civil Engineering to describe the environmental characteristics of the site, conduct an engineering evaluation, and propose possible remedial measures for dealing with the radioactive waste at the West Lake Landfill. In May 1986, ORAU sampled water from

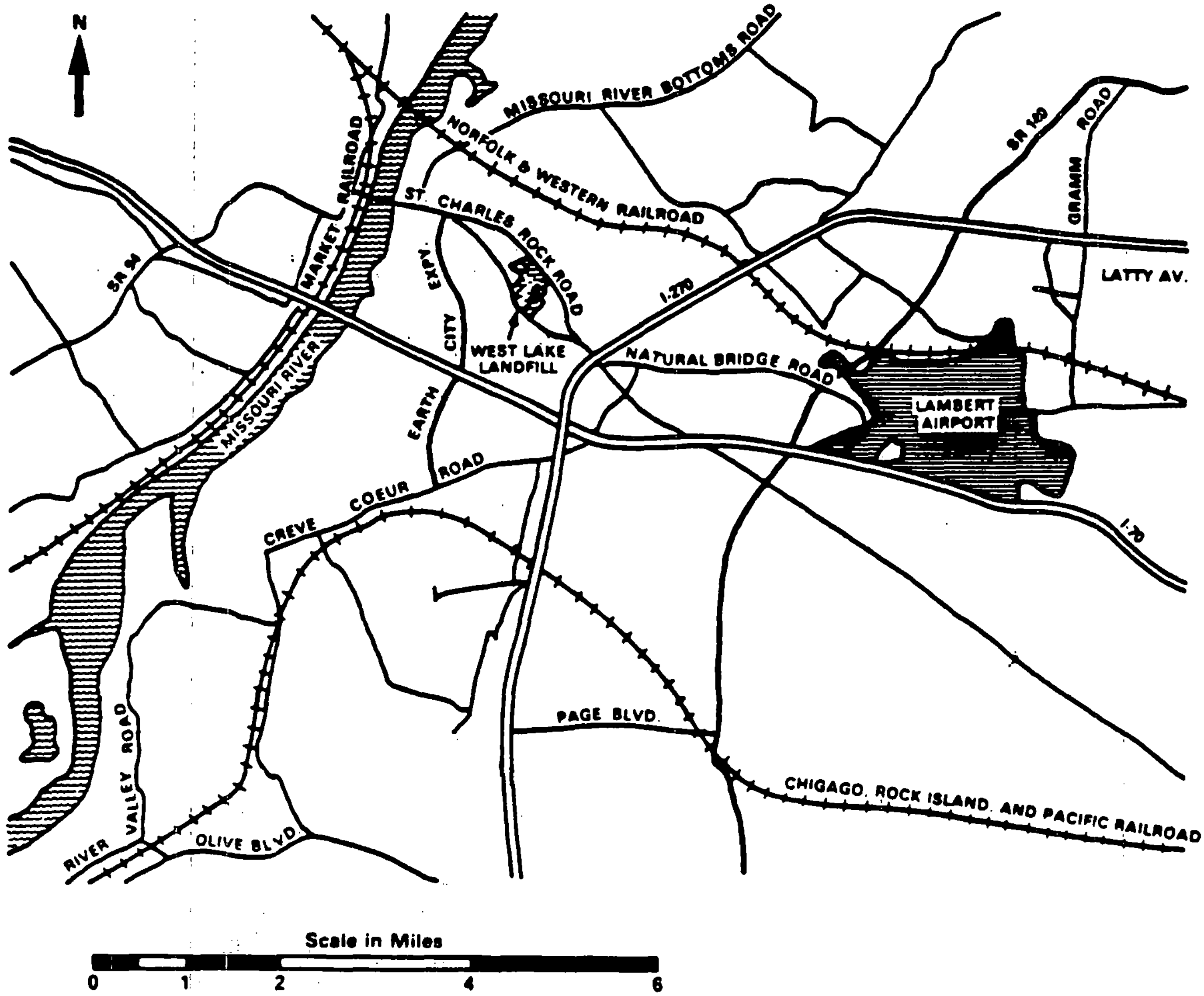

Figure 1.1 Location of West Lake Landfill

wells on and close to the landfill to determine if the radioactive material had migrated into the groundwater.

Information from all these sources forms the basis for this report.

2 SITE DESCRIPTION

This chapter presents a historical and environmental description of the West Lake Landfill site located in St. Louis County, Missouri.

2.1 Location

The 81-hectare (ha) (200-acre) West Lake Landfill property is situated between the St. Charles Rock Road and the Old St. Charles Rock Road in Bridgeton, Missouri. The southeastern and northwestern parts of the landfill abut farmland. Several commercial and industrial facilities are located near the landfill (Figure 2.1). The nearest residential area is a trailer park located approximately 1 km (0.6 mile) to the southeast. A major portion of the landfill (roughly the northern three-fourths of the site) is located on the floodplain, approximately 2 km (1.2 miles) from the Missouri River.

2.2 Zoning

The zoning plan obtained from the Bridgeton Planning and Zoning Department for properties on and adjacent to the landfill is shown in Figure 2.2. A portion of the landfill, including site Area 1, is zoned M-1, which is designated for light manufacturing; the northwest part of the landfill, including Area 2, is zoned as single-family residential (R-1). This R-1 zoning indicates the use to which the land was originally intended. However, the landfill was extended over the land zoned R-1, and the zoning plan was simply not changed to reflect the new usage. Other discrepancies between land use and zoning are found in the nearby Earth City Industrial Park (William Canney, Safety Supervisor of West Lake Landfill, Inc., personal communication, March 1984). The land across St. Charles Rock Road is zoned for light and heavy manufacturing. The remainder of the property surrounding the landfill is zoned residential and business.

2.3 History

The West Lake Landfill was started in 1962 for the disposal of municipal and industrial solid wastes, and to fill in the excavated pits from the quarry operations that had been performed at the site since 1939 (Canney, personal communication, March 1984). In 1974, the landfill was closed by the Missouri Department of Natural Resources (MDNR) (Karch, 1976). A new sanitary landfill, in an area of the West Lake Landfill property which is protected from ground-water contact, now operates under an MDNR permit.

This new part of the landfill was opened in 1974. The bottom is lined with clay and a leachate collection system has been installed. Leachate is pumped to a treatment system consisting of a lime precipitation unit followed in series by an aerated lagoon and two unaerated lagoons. The final lagoon effluent is discharged into St. Louis Metropolitan Sewer District sewers.

The quarrying operation ceased in the spring of 1987 because not enough "good rock" was left at the site.

2.4 Ownership

The West Lake Landfill was owned from 1939 until 1988 by West Lake Landfill, Inc., of 13570 St. Charles Rock Road, Bridgeton, Missouri. Most of the landfill was sold in 1988 to Laidlaw Industries, Inc. The two areas which contain the radioactive material were retained by West Lake Properties as the principal properties of a subsidiary named Rock Road Industries, Inc.

2.5 Contaminated Areas

Radioactive contamination at the West Lake Landfill has been identified in two separate soil bodies (Figure 2.3). Comparisons of radionuclide quantities and of the activity ratios between radionuclides not in secular equilibrium, indicate that the radioactive contamination in the separate soil bodies was derived from the same source, i.e., the Cotter Corporation's former Latty Avenue facility in Hazelwood, Missouri (NRC, NUREG/CR-2722).

The northern area (referred to as Area 2) of contamination shown on Figure 2.3 covers an area of 5.2 ha (13 acres) and lies above 5 to 6 m (16-20 ft) of landfill debris. The contaminated soil forms a more or less continuous layer from 1 to 4 m (3 to 13 ft) in thickness, and amounts to approximately 100,000 m^3 (130,000 yd^3). Some of this contaminated soil is near or at the surface, particularly along the face of the northwestern berm. Beneath the landfill debris, the soil profile consists of 1 to 2 m (3 to 7 ft) of floodplain top soil overlying 10 to 15 m (33 to 50 ft) of sand and gravel alluvium.

The southern area of contamination (referred to as Area 1) shown on Figure 2.3 covers approximately 1.1 ha (3 acres) and contains roughly 15,000 m^3 (20,000 yd^3) of contaminated soil. This body of soil is located east of the landfill's main office at a depth of about 1 m (3 to 5 ft), and is located over a former quarry pit, which was filled in with debris. The depth of debris beneath the contaminated soil is unknown, but is estimated to be 15 to 20 m (50 to 65 ft). Limestone bedrock underlies the landfill debris.

2.6 Topography

About 75% of the landfill site is located on the floodplain of the Missouri River. The site topography is subject to change because of the types of activities (e.g., landfilling and quarrying) performed there. Figure 2.3 shows a contour map of the site as of July 1986. The surface runoff follows several surface drains and ditches which run in a northwest direction and drain into the Missouri River.

2.7 Geology

2.7.1 Bedrock

Bedrock beneath the West Lake Landfill consists of Mississippian age limestone of the Meramacean Series of the St. Louis and Salem formations, which extends downward to an elevation of 58 m (190 ft) mean sea level (msl) (Figure 2.4).*

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*Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Missouri, Well Log Files.

The limestone is dense, bedded, and fairly pure except for intermittent layers which consist of abundant chert nodules. The Warsaw Formation--also of Mississippian age--lies directly beneath the limestone. The Warsaw is made up of approximately 12 m (38 ft) of slightly calcareous, dense shale; this grades into shaley limestone toward the middle of the formation (Figure 2.4) (Spreng, 1961). Bedrock beneath the site dips at an angle of 0.5° to the northeast. Eight kilometers (5 miles) east of the site, the attitude of the bedrock is reversed by the Florissant Dome; the bedrock dips radially outward from the apex of this dome at a low angle (Martin, 1966).

Since karst (solution) activity often occurs in carbonate rocks, the possibility of its occurrence in the West Lake Landfill area was considered. Brief observation of the quarry walls at the landfill suggests that some solution of the limestone has occurred, but this solution activity has apparently been limited (see Section 2.8.1) to minor widening of joints and bedding planes near the bedrock surface. Although karst activity within the limestone is relatively minor, the upper surface of the bedrock is irregular and pitted as a result of solution (Lutzen and Rockaway, 1971). This alteration of the bedrock surface is greatest beneath the Missouri River floodplain.

2.7.2 Soils

Soil material in this area may be divided into two categories: Missouri River alluvium and upland loessal soil. This demarcation is shown as the historical edge of the alluvial valley in Figure 2.5. The division is made on the basis of soil composition, depositional history, and physical properties. Because the West Lake Landfill lies over this transition zone, the surface material at the site varies considerably from southeast to northwest.

The Missouri River alluvium (Figure 2.6) ranges in thickness from 12 m (40 ft) beneath the landfill site to more than 30 m (100 ft) at mid-valley (Figure 2.7). The upper 3 m (10 ft) of the soil profile consists of organic silts and clays, that have been deposited by the Missouri River during floods.* Below this

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*Missouri Department of Natural Resources, Division of Geology and Land Survey, Rolla, Missouri, Well Log Files.

surface layer, the soil becomes sandy and grades to gravel at depths greater than 5 to 10 m (16 to 33 ft). Because of the effects of channel scour, which continues to grade the sediment after its initial deposition, the alluvium is fairly homogeneous in a horizontal direction and becomes progressively coarser with depth (Goodfield, 1965). At the edges of the floodplain, the alluvium is not as well graded, and a large amount of fine material is present in the deeper sand and gravel.

The upland loessal soil (Figure 2.8) is generally thinner than the floodplain soil, being usually less than 12 m (39 ft) thick, and was deposited during the age of Pleistocene glaciation. The loess consists of silt-sized particles that were transported by wind and deposited as a blanket over much of Missouri and Illinois. On the hills near the West Lake Landfill, the loess layer may be as much as 24 m (79 ft) thick. It consists of 6 to 9 m (20 to 30 ft) of fairly pure silt (Peoria loess) overlying 6 to 15 m (20 to 49 ft) of clay silt (Roxana loess) (Lutzen and Rockaway, 1971). This loess forms the hills to the southeast of the landfill, but it has long ago been removed from the landfill site and most of the surrounding valleys by erosion. The upper 1 m (3 ft) of the loess has been altered to form a thin soil profile. It should be noted that loess has a vertical permeability which is far greater than its horizontal permeability (Freeze and Cherry, 1979). The total permeability of loess is greatly increased by disturbance. The individual silt grains are generally quite angular, and therefore may not be effectively compacted by the methods commonly used to consolidate clay. The technique most effective in the compaction of loess would employ vibration beneath a surcharge. A relict soil profile from 5 to 10 m (16 to 33 ft) thick lies beneath the loess and directly on top of the bedrock. This soil was formed as a residuum before Pleistocene glaciation and was subsequently covered by the loess blanket. This soil is a highly consolidated clay containing abundant chert fragments (Lutzen and Rockaway, 1971). In addition to the natural geologic properties of the landfill, human disturbance of the soil must also be considered since material within the landfill itself can either limit or facilitate migration of leachate to the Missouri River alluvial aquifer.

In order to prevent downward movement of leachate, it is now a common practice to place a layer of compacted clay beneath sanitary landfills. Newer portions of the landfill (constructed since 1974) have 2 to 3 m (7 to 10 ft) of clay at the base and around the sides. Waste is covered every day with 15 cm (6 in.) of compacted soil; the cover soil presently used is loess (of soil classifications CL and A4) taken from southeast of the landfill (Reitz and Jens, 1983a). If not properly compacted, this material may have a permeability of 0.0001 cm/sec (0.00004 in./sec) or more. It is not known what procedures for compaction, if any, were used at the landfill before 1974 since the site was unregulated in design as well as in materials which were accepted for disposal. It is believed, however, that there is no liner present beneath the northwestern portion of the landfill, and that sanitary (and, possibly, some hazardous) material was placed directly on the original ground surface. Since waste was periodically covered with soil to minimize rodent and odor problems, the landfill probably consists of discrete layers of waste separated by thin soil layers. Both areas containing radioactive material are in these presumably unlined above-ground portions of the landfill. *

2.8 Hydrology

2.8.1 Subsurface Hydrology

Groundwater flow in the area surrounding the West Lake site is through two aquifers: the Missouri River alluvium and the shallow limestone bedrock. The base of the limestone aquifer is formed by the relatively impermeable Warsaw shale at an elevation of about 58 m (190 ft) msl (Figure 2.4). This shale layer has been reached, but not disturbed, by quarrying operations. Therefore, the Warsaw shale acts as an aquiclude, making contamination of the deeper limestone very unlikely. The Mississippian limestone beds have very low intergranular permeability in an undisturbed state (Miller, 1977). However, a strong leachate enters the quarry pit at an elevation of about 67 m (220 ft) msl (pt. A on Figure 2.5). This leachate is migrating vertically through more than 30 m (98 ft) of limestone. Explosive detonations associated with quarrying operations will tend to cause fractures to propagate in the quarry wall. These fractures have probably extended less than 10 m (33 ft) into the rock from the quarry face. Beyond this, the rock probably remains undisturbed. These fractures will tend to increase inflow to the quarry pit and allow leachate to percolate downward through the fractured zone. Thus, leachate inflow to the quarry pit is not evidence of large-scale contamination of the limestone aquifer. The only other mechanism by which leachate could travel rapidly through the limestone is by transport through solution channels. Landfill consultants and quarry operators maintain that the limestone is fairly intact (Canney, personal communication, September 1983), and superficial observation of the quarry walls seems to support this conclusion. Since the limestone is fairly impervious, and groundwater flows in most areas from the bedrock into the alluvium, contamination of water in the bedrock aquifer does not appear likely. *

The water table of the Missouri River floodplain is generally within 3 m (10 ft) of the ground surface, but at many points it is even shallower. At any one time, the water levels and flow directions are influenced by both the river stage and the amount of water entering the floodplain from adjacent upland areas. A high river stage tends to shift the groundwater gradient to the north, in a direction that more closely parallels the Missouri River. Local rainfall will shift the groundwater gradient to the west, toward the river and along the fall of the ground surface. This is inferred from water levels measured in monitoring wells at the West Lake site. The fact that groundwater levels commonly fluctuate more than does the Missouri River level, indicates that upland-derived recharge exerts a great deal of influence over groundwater flow at the West Lake site. This influence decreases toward the river.

The deep Missouri River alluvium acts as a single aquifer of very high permeability. This aquifer is relatively homogeneous in a downstream direction, and decreases in permeability near the valley walls. The deeper alluvium is covered by 2 to 4 m (7 to 13 ft) of organic silts and clays that may locally contain a large fraction of sand-sized particles. Water levels recorded between November 1983 and March 1984 in monitoring wells at West Lake* indicate a groundwater gradient of 0.005 flowing in a N 30°W direction beneath the northern portion of the landfill. This represents the likely direction of any possible leachate migration from the landfill (Figure 2.5).

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*Data supplied by Reitz and Jens engineering firm, St.Louis, 1984.

The alluvial aquifer recharges from upland areas from three sources: seepage from loess and bedrock bordering the valley, channel underflow of upland streams entering the valley, and seepage losses from streams as they cross the floodplain. Of these sources, streams and their underflow represent the main source of upland recharge to the alluvial aquifer. Streams entering the floodplain raise the water table in a fan-shaped pattern radiating outward from their point of entrance to the plain. In areas where streams are not present, the water slopes downward from the hills, steeply at first and then gently to the level of the free water surface in the Missouri River channel. The situations described above do not take into account the effect of variations in permeability of the shallow soil layer. Aerial photography of the site indicates that a filled backchannel (oxbow lake) type of soil deposit is present along the southwest boundary of the landfill (USDA, 1953). This deposit is probably composed of fine-grained material to the depth of the former channel (6 to 10 m) (20 to 33 ft). This deposit may tend to hamper communication between shallow groundwater on opposite sides of the deposit.

Since no other recharge sources exist above the level of the floodplain, the only water available to leach the landfill debris is that resulting from rainfall infiltrating the landfill surface. Because the underlying alluvial aquifer is highly permeable, there will be little "mounding" of water beneath the landfill. Because the northern portion of the landfill has a level surface it is likely that at least half of the rainfall infiltrates the surface. The remaining rainfall is lost to evapotranspiration and (to a lesser degree) surface runoff. Due to the height of the berm, temporary impoundment of surface runoff is a common occurrence.

No public water supplies are drawn from the alluvial aquifer near the West Lake Landfill. It is believed that only one private well (Figure 2.9) in the vicinity of the landfill is used as a drinking water supply. This well is 2.2 km (1.4 miles) N 35°W of the former Butler-type Building location on the West Lake Landfill. In 1981, analysis showed water in this well to be fairly hard (natural origins) but otherwise of good quality (Long, 1981).

Water in the Missouri River alluvium is hard and usually contains a high concentration of iron and manganese (Miller, 1977). The amount of dissolved solids present in the water of the alluvial aquifer varies greatly; purity increases toward mid-valley where groundwater velocity is greatest. A water sample from a well in the alluvium 3 km (1.9 miles) north of the landfill had a total dissolved solids content of 510 mg/liter and total hardness as $CaCO_3$ of 415 mg/liter. Water in the limestone bedrock generally has a hardness greater than 180 mg/liter as $CaCO_3$ equivalent (Emmett and Jeffery, 1968). Total dissolved solids range from 311 to 970 mg/liter. Water in the limestone aquifer may contain a large amount of sulfate of natural origin (Miller, 1977).

2.8.2 Surface Hydrology

Because of the extremely low slope of the Missouri River flood plain surface, precipitation falling on the plain itself generally infiltrates the soil rather than running off the surface. The only streams present on the floodplain are those that originate in upland areas. Drainage patterns on the plain (Figure 2.9) have been radically altered by flood control measures taken to protect Earth City (Figure 2.1) and by drainage of swamps and marshes. Before these alterations, Creve Coeur Creek passed just south of the landfill, and drained a fairly large area. It has since been redirected to discharge into the Missouri River upstream (south) of St. Charles (Figure 2.9). The old channel still carries some water, and empties into the Missouri River 45.2 km (28 miles) upstream from the confluence with the Mississippi River. Near the landfill, this stream is usually dry. As it crosses the flood plain, the creek passes through shallow lakes which provide a more or less continuous flow to the Missouri River throughout the year. A second stream, Cowmire Creek, crosses the floodplain east of the site. This stream flows northward and joins a back-water portion of the Missouri River at kilometer 35.4 (22 miles). Because of the relationship which exists between river level and groundwater level in portions of the floodplain near the river, these streams may either lose flow (at low stage) or gain flow (at high stage).

The present channel of the Missouri River lies about 3 km (2 miles) west and northwest of the landfill. Early land surveys of this area indicate that 200 years ago the channel was located several hundred meters to the east (toward the landfill) of its present course (Reitz and Jens, 1983b). The Missouri River has a surface slope of about 0.00018 (Long, 1981). River stage at St. Charles [kilometer 45.2 (mile 28)] is zero for a water level of 126.1 m (413.7 ft) msl (Reitz and Jens, 1983a). Average discharge of the Missouri River is 2190 m^3/s (77,300 ft^3/s), with a maximum flow of 2850 m^3/s (101,000 ft^3/s) for the period of April through July, and a minimum flow of 1140 m^3/s (40,300 ft^3/s) in January and December (Miller, 1977). Some average properties of Missouri River water for the period 1951-1970 were: alkalinity = 150 mg/liter as $CaCO_3$ equivalent; hardness = 209 mg/liter as $CaCO_3$ equivalent; pH = 8.1; and turbidity = 694 JTU (Jackson turbidity unit).

Water supplies are drawn from the Missouri River at kilometer 46.6 (mile 29) for the city of St. Charles, and the intake is located on the north bank of the river. Another intake at kilometer 33 (mile 20.5) is for the St. Louis Water Company's North County plant (Reitz and Jens, 1983a).

The city of St. Louis takes water from the Mississippi River, which joins the Missouri River downstream from the landfill. In this segment of the river, the two flow-streams have not completely mixed and the water derived from the Missouri River is still flowing as a stream along the west bank of the Mississippi River channel*. The intake structures for St. Louis are on the east bank of the river so that the water drawn is derived from the upper Mississippi.

2.9 Meteorology

The climate of the West Lake area is typical of the midwestern United States, in that there are four distinct seasons. Winters are generally not too severe and summers are hot with high humidity. First frosts usually occur in October; and freezing temperatures generally do not persist past March. Rainfall is greatest in the warmer months, (about one-quarter of the annual precipitation occurs in May and June) (Figure 2.10) (NRC, 1981). In July and August, thunderstorms are common, and are often accompanied by short periods of heavy rainfall. Average annual precipitation is 897 mm (35.3 in.), which includes the average annual snowfall of 437 mm (17.2 inches snow). Average relative humidity is 68%,

*Ned Harvey, hydrologist with the USGS, telephone communication, August 1983.

and humidities over 80% are common during the summer. Wind during the period of December through April is generally from the northwest; winds blow mainly from the south throughout the remainder of the year. A compilation of hourly wind observations shows that although the wind resultant is fairly consistent on a monthly basis, the wind actually shifts a good deal and is very well distributed in all directions (Figure 2.11) (NRC, 1981; U.S. Department of Commerce, 1960).

Meteorological data used is from Lambert Field International Airport which is 6 km (3.7 miles) east of the West Lake site. Temperature and precipitation data are also representative of West Lake. However, because of differences in topography between Lambert Field and the site, the actual wind directions at West Lake may be slightly skewed in a NE-SW direction parallel to the Missouri River valley.

2.10 Ecology

The West Lake Landfill is biologically and ecologically diverse. Rather than a single ecological system (e.g., a prairie), it is a mosaic of small habitats associated with

(1) moist bottomland and farmland adjacent to the perimeter berm

(2) poor quality drier soils on the upper exterior and interior slopes of the berm

(3) an irregular waste ground surface associated with the inactive portion of the landfill

(4) aquatic ecosystems present in low spots on the waste ground surface

Generally, the natural systems which are present are limited by operations in the active portion of the landfill and form a corridor along the perimeter berm from near well site 75 (Figure 2.5), on the Old St. Charles Rock Road, clockwise to the main entrance to the landfill near well site 68, along St. Charles Rock

Road. The following observation and descriptions demonstrate the biological variety of these sites.

The flora of the perimeter berm extending from the southwest clockwise to the area of the main entrance to the landfill present a series of contrasts. Along the Old St. Charles Rock Road, the bottom and lower slope of the berm is heavily influenced by the nearby mature silver maple (Acer saccharinum), boxelder (Acer negundo), oak (Quercus), sycamore (Platanus), green ash (Fraximus pennsylvanica), and eastern cottonwood (Populus deltoides) trees associated with the old channel of Creve Coeur Creek. At the corner, between wells 59 and 60 (Figure 2.5), large silver maple and boxelder trees form a dense stand in the moist soils at the base of the berm. The density of these trees declines on this slope extending toward the north (well 61) and the Butler-type Building corner. The extension of this slope toward the northwest is dominated by a dense willow-like thicket in which a few eastern cottonwoods and a hawthorn tree have established. From this northwest corner of the landfill to the eastern limit of the trees between the landfill and St. Charles Rock Road (well 65), the exterior slope of the berm is dominated by dense stands of small and large eastern cottonwoods. This latter occurrence reflects the influence of the well-established eastern cottonwoods and sycamores associated with the permanent pond just north of this site (Figure 2.9). The ground cover along these exterior slopes consists of grasses, forbs, plants common to disturbed areas, seedling cottonwoods, and shrubs. A well-manicured grass groundcover continues from the limit of the trees to the area around the main entrance of the landfill and well 68. This vegetation contributes to the partial stabilization of the steep exterior slopes.

The somewhat drier top and the short, interior slope of the berm, colonized by prairie grasses such as bluestem (Andropogon), blends into the irregular surface of the inactive portion of the landfill. Depressions in this surface allow water to collect and tall grasses, foxtail, and plants characteristic of disturbed areas [e.g., ragweed (Ambrosia), mullein (Verbascum), pokeweed (Phytolacca), cinquefoil (Potentilla), sunflower (Helianthus), and plantain (Plantago)] are replaced by characteristic wetland species [e.g., algae (Spirogyra), cattails (Typha), sedges (Carex), and smartweed (Polygonium)]. Young eastern cottonwoods are established at several of these wet sites.

Generally, the surface vegetation of the inactive landfill gives way to barren waste ground around the Butler-type Building location and the barren terrain associated with recent landfill activities.

Animals were observed associated with these habitats. Cottontail rabbits (Sylvilagus) were encountered most frequently and their fecal pellets were observed on the landfill. Density of fecal material was particularly heavy in the thickets on the exterior slopes of the perimeter berm. In this regard, coyote (Canis latrans) feces containing rabbit fur were observed. Small mammals (rodents) were not seen but could certainly be present in these areas. Large ungulates also were not sighted, but tracks and feces of white-tailed deer indicate that they utilize the landfill.

The only birds observed were a crow (Corvus), several robins (Turdus), and white-crowned sparrows (Zonotrichia leucophrys). This certainly does not reflect the extent to which birds utilize these habitats, for observations were made early in the spring. It is readily apparent that returning migratory passerines would utilize the surface vegetation and berm thickets for nesting, cover, and feed later in the season. It is also possible that waterfowl could utilize the permanent ponds on the landfill and adjacent to St. Charles Rock Road. Twelve scaup (Aythya) and mallards (Anas) were observed on the lagoon which serves as part of the landfill waste water treatment facility.

Small puddles contained characteristic aquatic invertebrates and at least two species of amphibians. Casual examination of these shallow waters revealed three genera of snails (Physa, Lymnaea, Helisoma), an isopod (Asnellus), cyclopoid copepods, and cladocerans. Aquatic insect larvae were not observed; however, this does not rule out their presence. The sighting of a bullfrog tadpole (Rana catesbeiana) and audition of spring peepers (Hyla), indicates these ponds are utilized as breeding sites. No fish were observed in these puddles on the landfill surface; however, a dead gizzard shad (Dorsoma cepedianum) was seen in the pond adjacent to St. Charles Rock Road. The only reptiles seen were the water snake (Nerodia) and the garter snake (Thamnophis).

Although the northwest inactive portion of the landfill is posted with "No Trespassing" signs, it was evident that humans do encroach on these habitats.

Fishing tackle was found tangled in power lines and trees, and spent small-gauge shotgun shells were found on the landfill surface and berms.

2.11 Demographics

The West Lake Landfill is located in the northwestern portion of the city of Bridgeton, in St. Louis County, Missouri. Earth City Industrial Park is located on the floodplain 1.5 to 2 km (0.9 to 1.2 miles) northwest of the landfill. Population density on the floodplain is generally less than 10 persons per square kilometer (26 persons per square mile); and the daytime population (including factory workers) is much greater than the number of full-time residents.

Major highways in the area include Interstate 70 (I-70) and Interstate 270 (I-270), which meet south of the landfill at Natural Bridge Junction (Figure 1.1). The Earth City Expressway and St. Charles Rock Road lie, respectively, west and east of the landfill. The Norfolk and Western Railroad passes about 1 km (0.6 mile) from the northern portion of the landfill (Figure 1.1). Lambert Field International Airport is located 6 km (3.7 miles) east of the West Lake Landfill.

In addition to factories at Earth City, plants are operated by Ralston-Purina and Hussman Refrigeration across St. Charles Rock Road. The employees of these two plants probably comprise the largest group of individuals in close proximity to the contaminated areas for significant periods of time. The Ralston-Purina facilities are located 0.4 km (0.2 mile) northeast of the Butler-type Building location at the landfill. Considering that land in this area is relatively inexpensive and that much of it is zoned for manufacturing, industrial development on the floodplain will likely increase in the future.

Two small residential communities are present near the West Lake Landfill. Spanish Lake Village consists of about 90 homes and is located 1.5 km (0.9 mile) south of the landfill, and a small trailer court lies across St. Charles Rock Road, 1.5 km (0.9 mile) southeast of the site (Figure 2.1). Subdivisions are presently being developed 2 to 3 km (1.2 to 1.9 miles) east and southeast of the landfill in the hills above the floodplain. Ten or more houses lie east of the landfill scattered along Taussig Road. The city of St. Charles is located north of the Missouri River at a distance greater than 3 km (1.9 miles) from the landfill.

Areas south of the West Lake Landfill are zoned residential; areas on the other sides are zoned for manufacturing and business (Figure 2.2). Most of the landfill is zoned for light manufacturing (M-1). However, approximately 0.3 km^2 (0.12 mi^2) of the northern portion of the landfill is zoned for residential use; this includes the contaminated area around the Butler-type Building site. The field northwest of the landfill between Old St. Charles Rock Road and St. Charles Rock Road is under cultivation. Trends indicate that the population of this area will increase, but the land will probably be used primarily for industrial facilities.

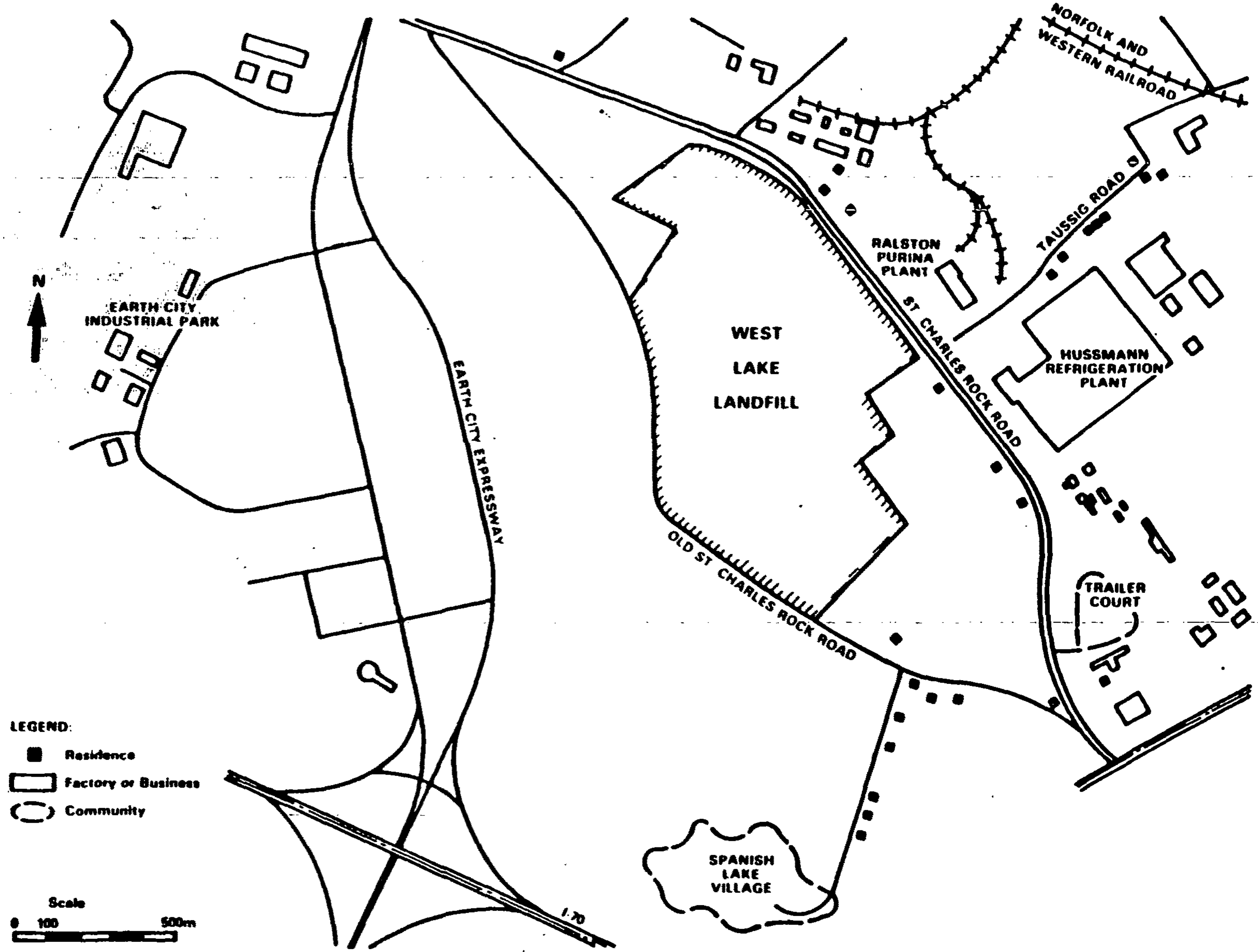


Figure 2.1 Land use around West Lake Landfill site

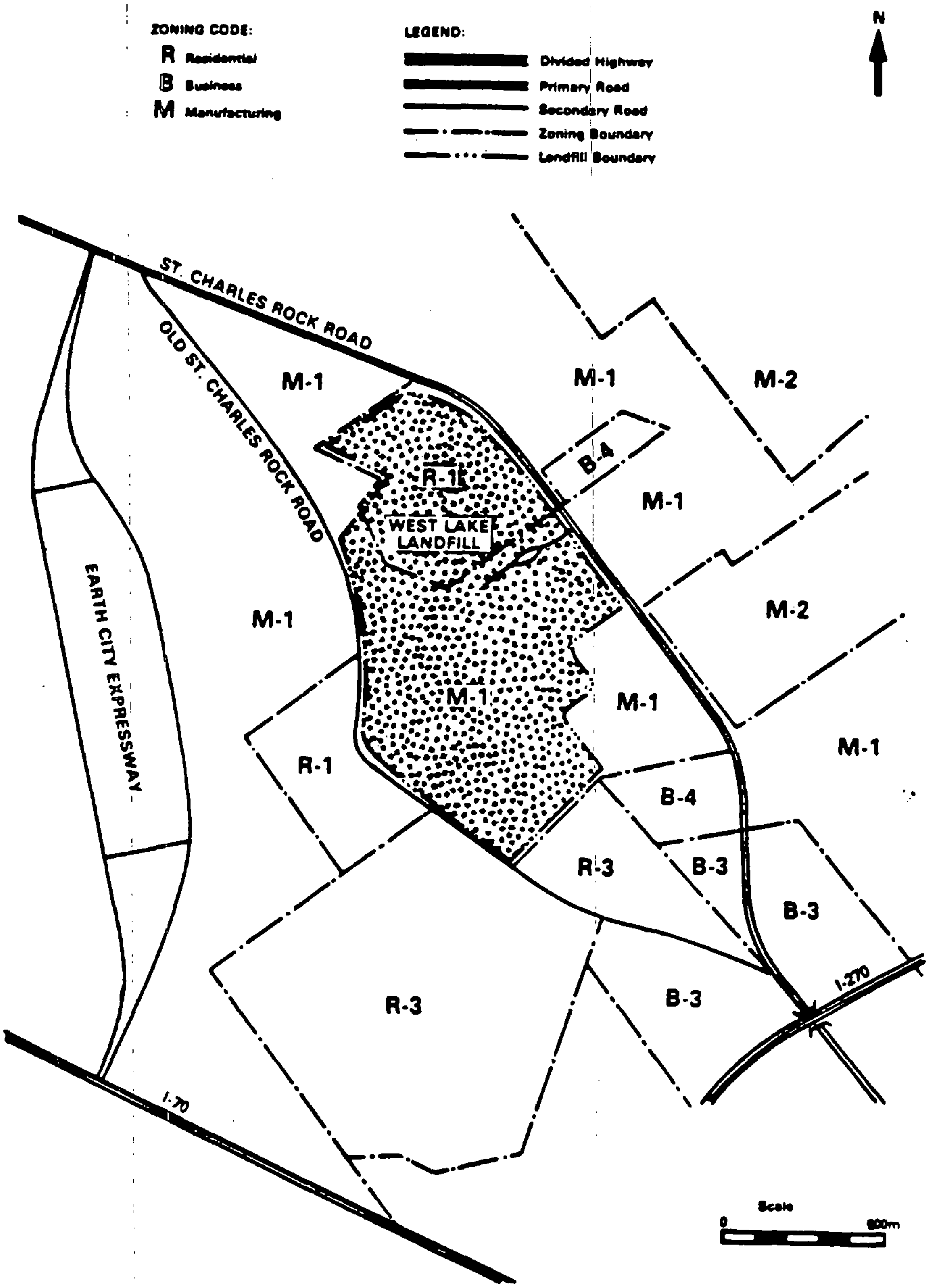


Figure 2.2 Zoning plan of West Lake area (June 1984)

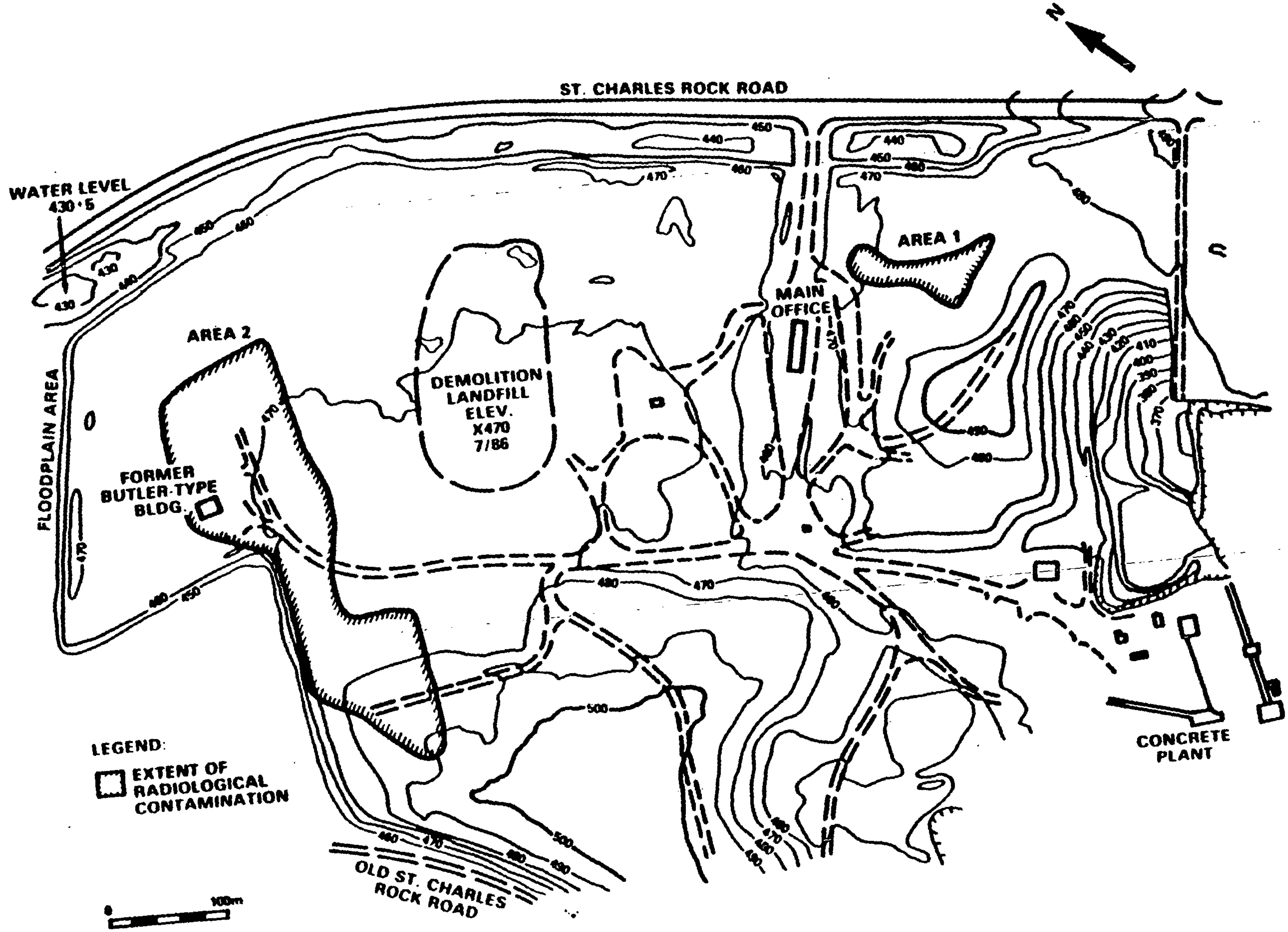


Figure 2.3 Site topography and extent of contamination.

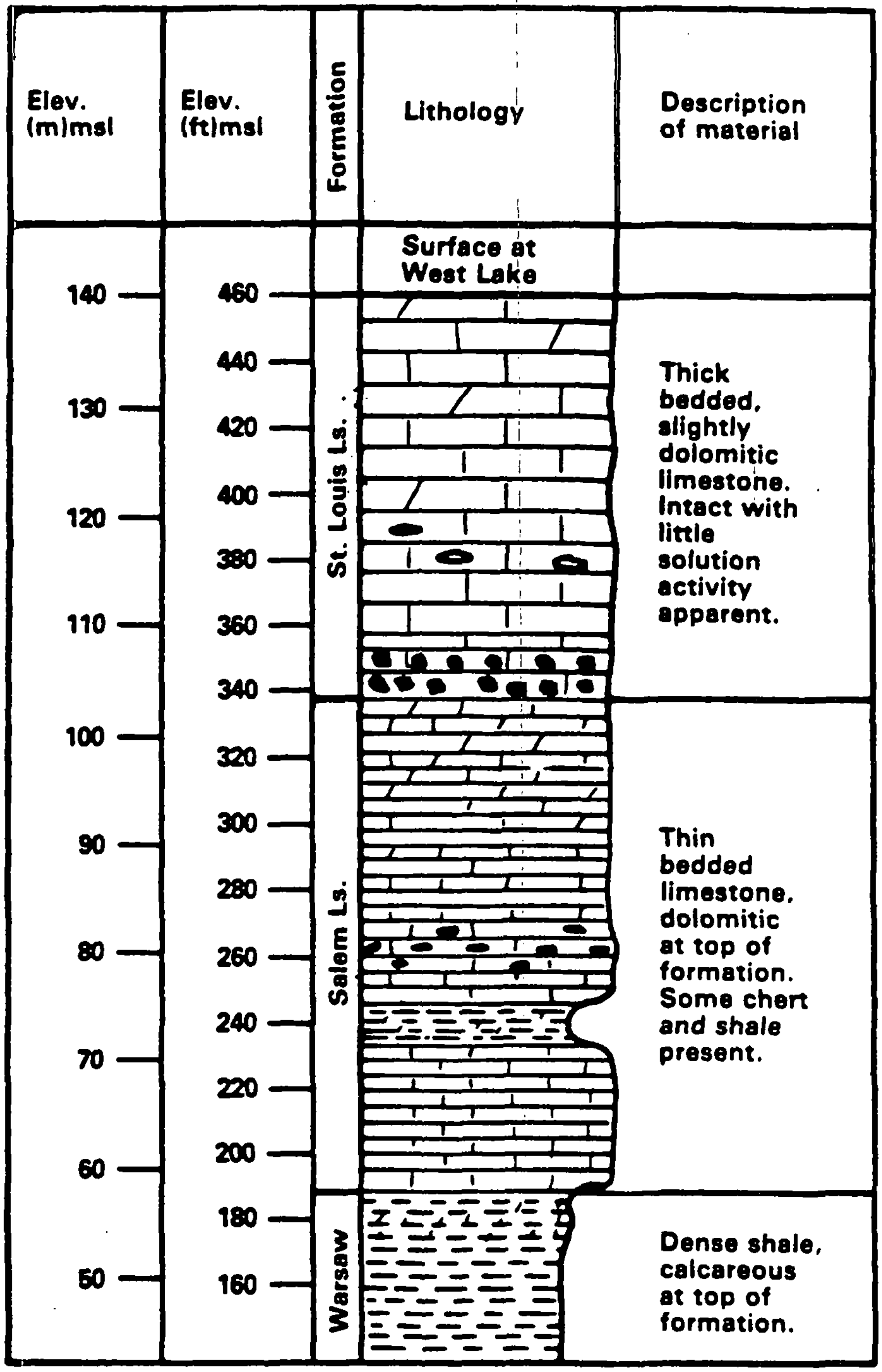


Figure 2.4 Bedrock stratigraphy

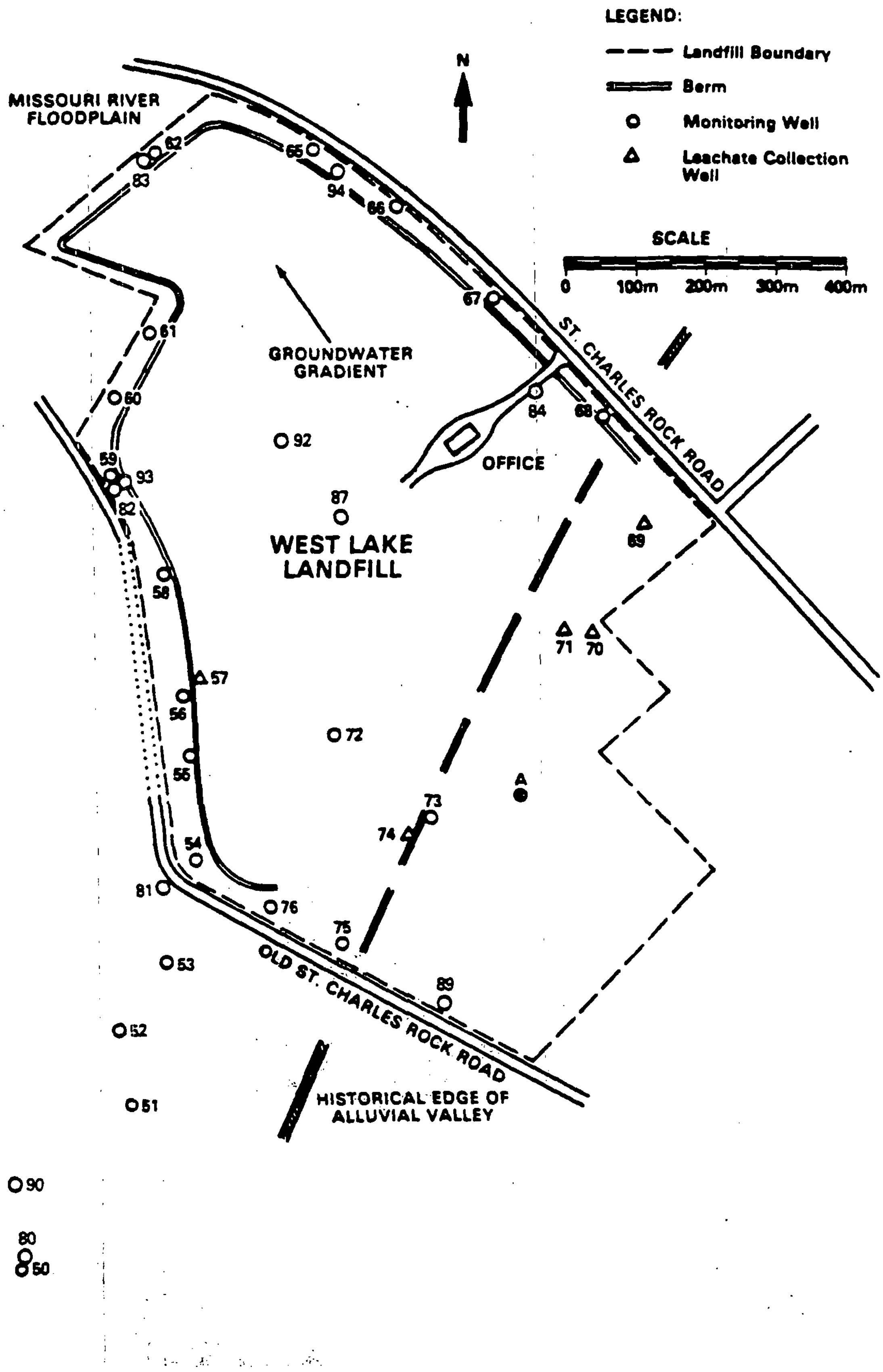


Figure 2.5 Location of monitoring wells

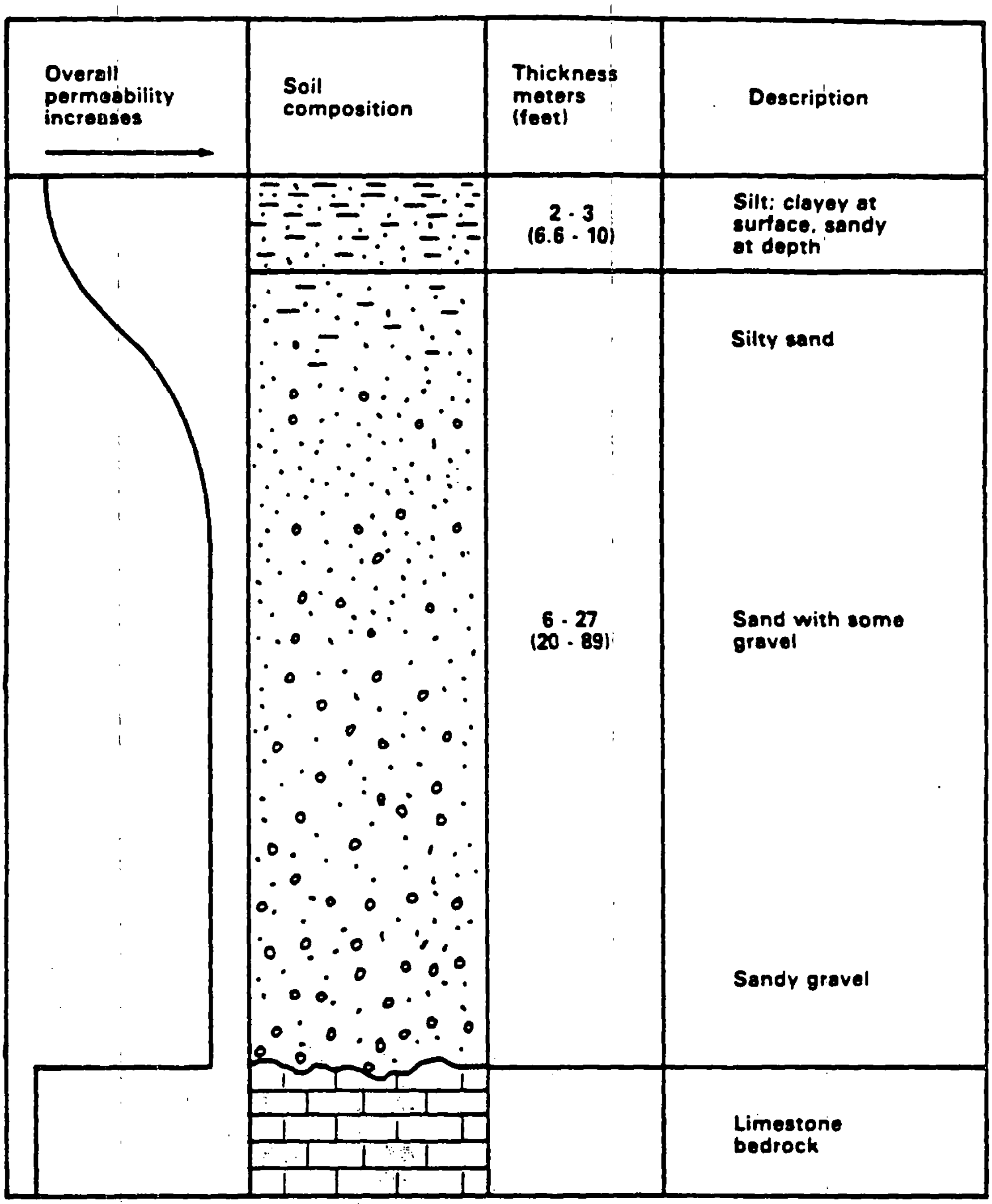


Figure 2.6 Soil profile of river alluvium

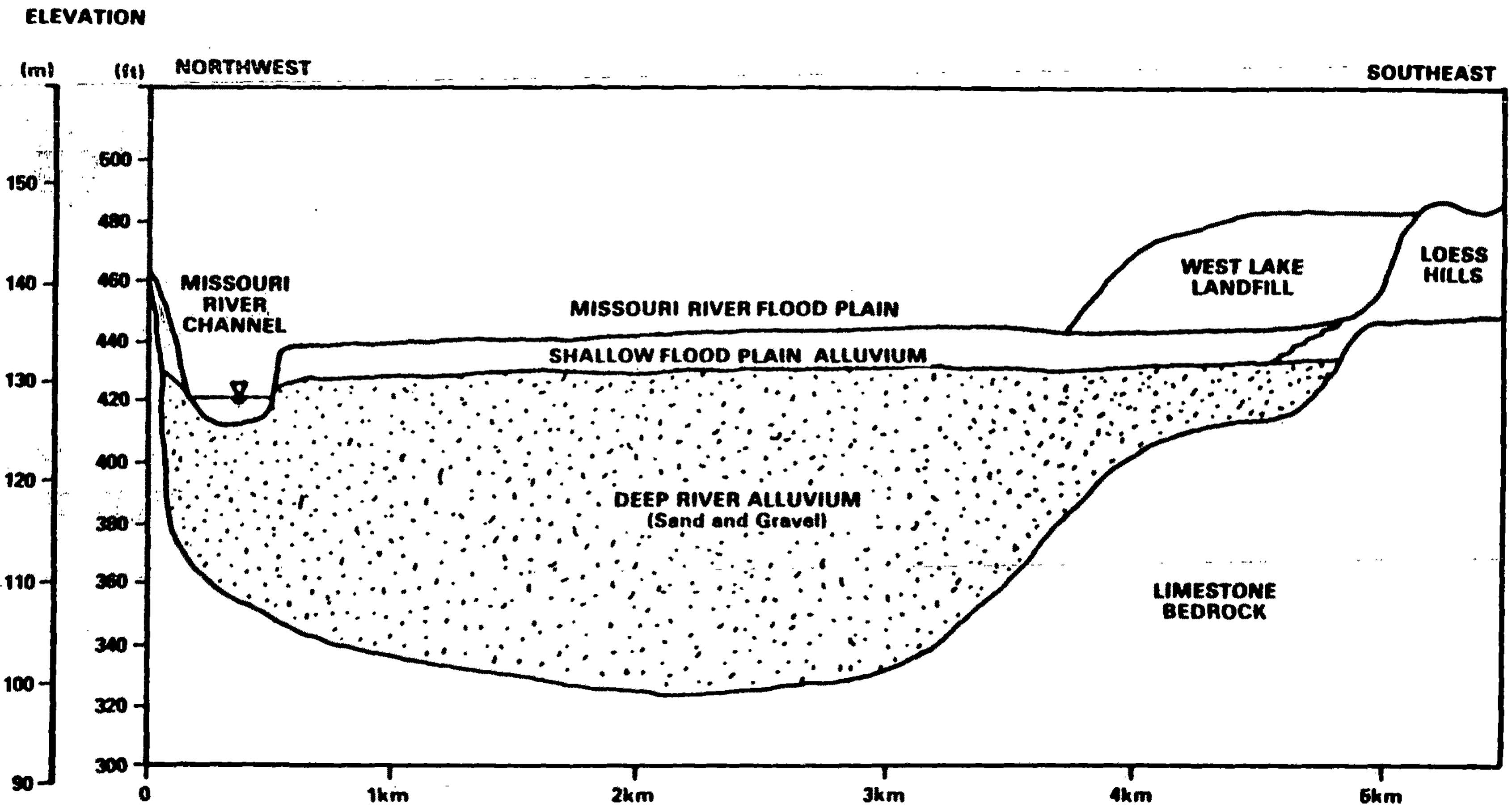


Figure 2.7 Cross-section of Missouri River alluvial valley

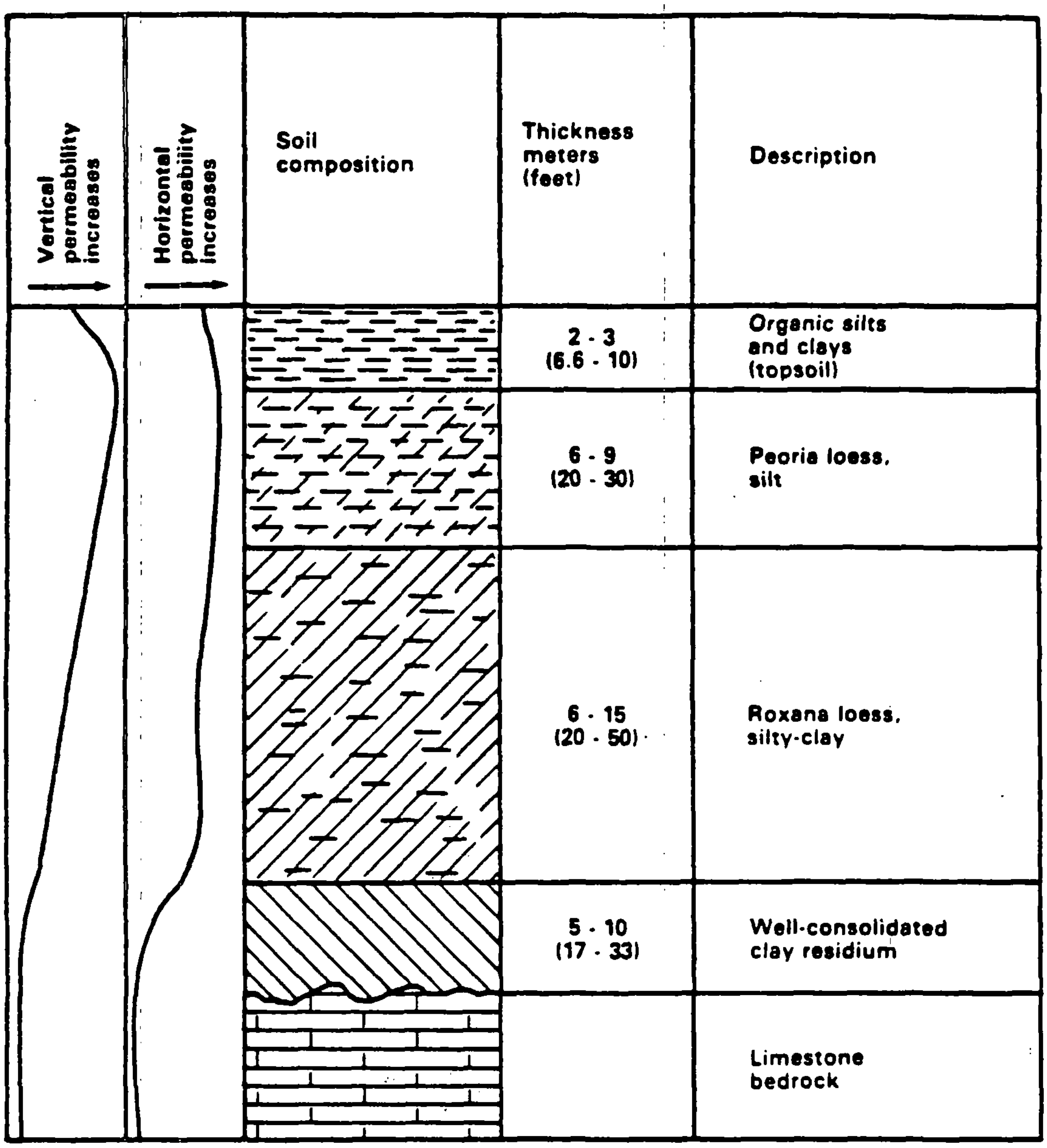


Figure 2.8 Soil profile of upland loessal soil

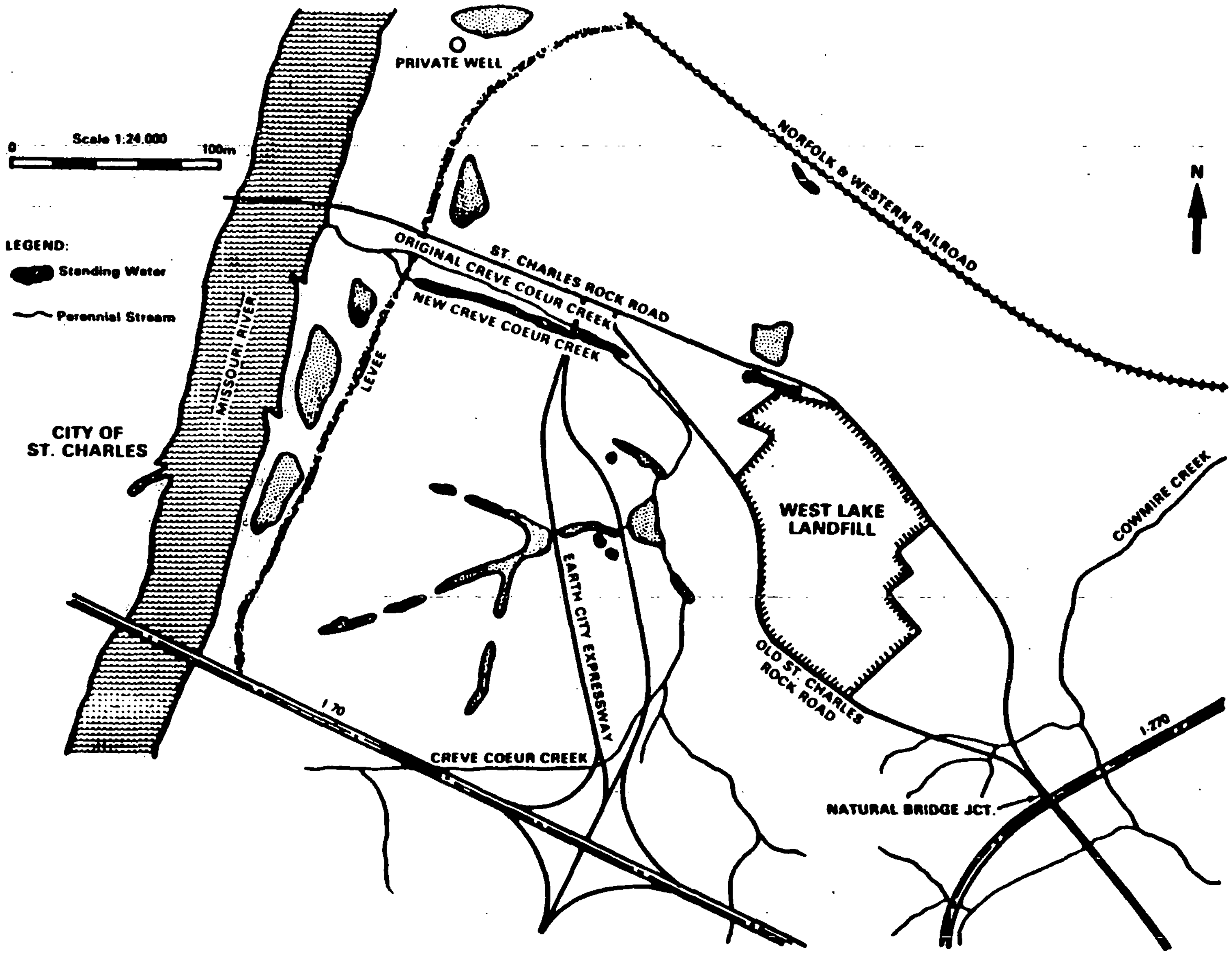


Figure 2.9 Surface hydrology of West Lake area

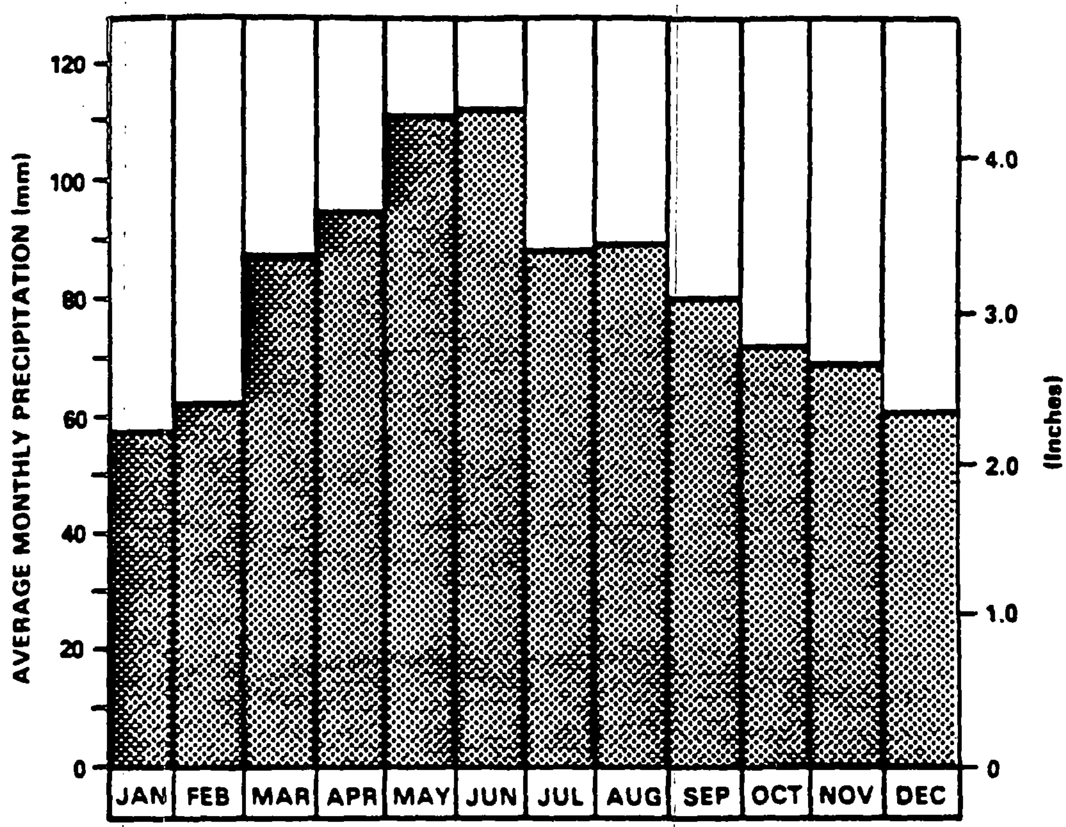
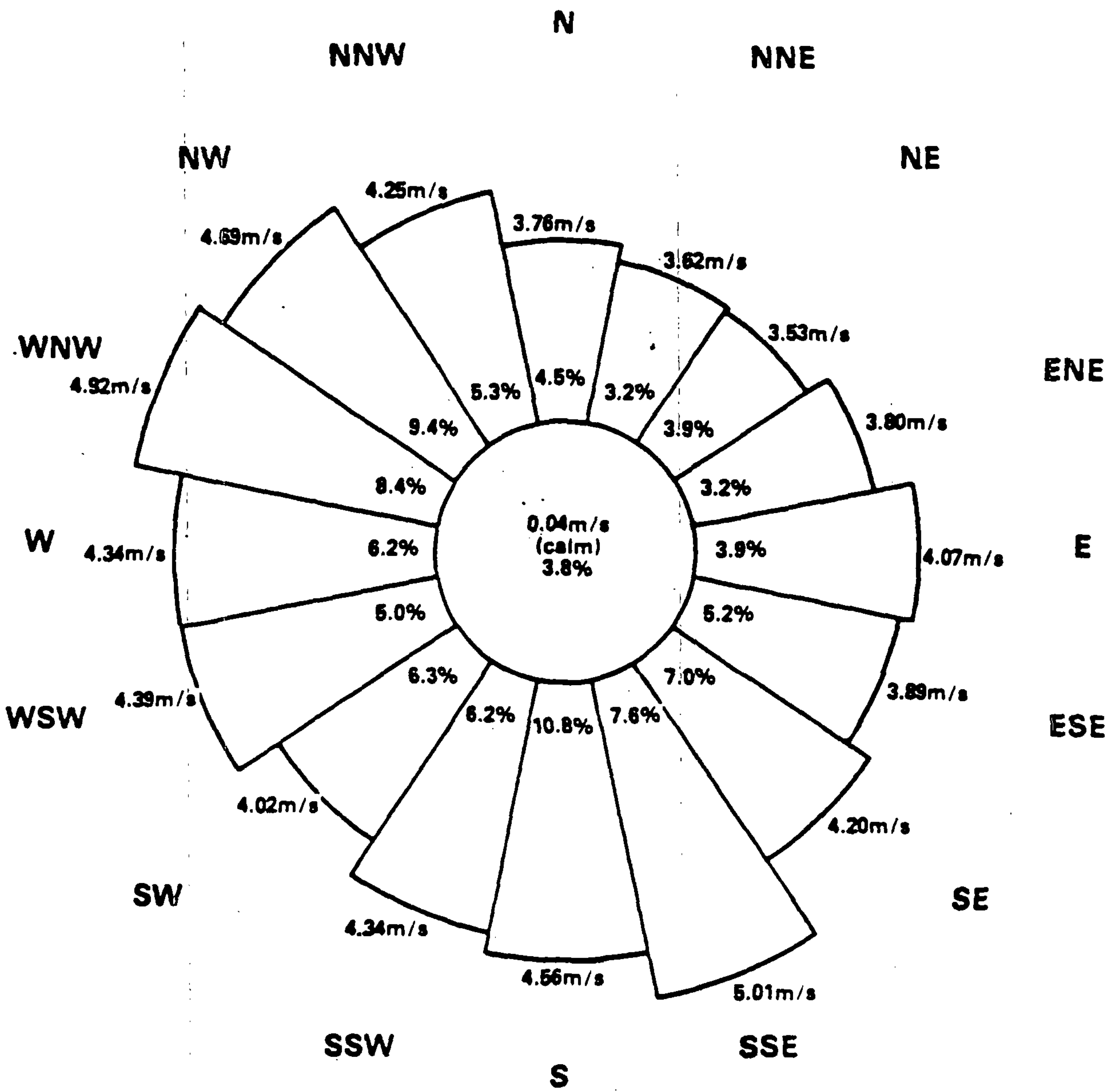


Figure 2.10 Average monthly precipitation at Lambert Field International Airport



Wind rose is for Lambert Field International Airport, Hazelwood, Missouri, and shows the percentage of hourly observations in each direction along with the average speed in that direction; for example: wind blew from the north 4.5% of the time at an average speed of 3.76 m/s.

Figure 2.11 Wind distribution for West Lake area

3 RADIOLOGICAL CHARACTERIZATION OF THE SITE

3.1 Radiological Surveillance

Approximately 43,000 mt (47,000 tons) of contaminated soil were reported to have been disposed of in the landfill. A fly-over radiological survey performed for the NRC in 1978 identified two areas of contamination at the West Lake Landfill.

Subsequently, from August 1980 through the summer of 1981, the Radiation Management Corporation (RMC), under contract to the NRC, performed an onsite evaluation of the West Lake Landfill (NRC, NUREG/CR-2722). The purpose of this survey was to clearly define the radiological conditions at the landfill. The results were to be utilized in performing an engineering evaluation to determine if remedial actions should and could be taken.

The area to be surveyed was divided into 10-m (33-ft) grid blocks and included the following measurements:

(1) external gamma exposure rates 1 m (3.3 ft) above the surfaces and beta-gamma count rates 1 cm (0.4 in.) above surfaces

(2) radionuclide concentrations in surface soils

(3) radionuclide concentrations in subsurface deposits

(4) gross activity and radionuclide concentrations in surface and subsurface water samples

(5) radon flux emanating from surfaces

(6) airborne radioactivity

(7) gross activity in vegetation

3.2 Survey Results

External Gamma

Figure 3.1 shows the two areas of elevated external radiation levels as they existed in November 1980, at the time of the preliminary RMC site survey. As can be seen, both areas contained locations where levels exceeded 100 μR/hr at 1 m (3.3 ft). In Area 2, gamma levels as high as 3000 to 4000 μR/hr were detected. The total areas exceeding 20 μR/hr were about 1.2 ha (3 acres) in Area 1 and 3.6 ha (9 acres) in Area 2.

External gamma levels measured in May and July of 1981 decreased significantly, especially in Area 1, because approximately 1.2 m (4 ft) of sanitary fill was added to the entire area and an equal amount of construction fill was added to most of Area 2. As a result, only a few hundred square meters (a few thousand square feet) in Area 1 exceed 20 μR/hr. In Area 2, the total area exceeding 20 μR/hr decreased by about 10%, and the highest levels were about 1600 μR/hr, near the location of the Butler-type building.

Surface Soil Analyses

A total of 61 surface soil samples were gathered and analyzed on site for gamma activity. Samples were normally stored 10 to 14 days to allow ingrowth of radium daughters. Concentrations of U-238, Ra-226 (from Pb-214 and Bi-214), Ra-223, Pb-211, and Pb-212 were determined for each sample. Surface soil samples are located in Figures 3.2 and 3.3.

In all soil samples, only uranium and/or thorium decay chain nuclides and K-40 were detected. Offsite background samples were on the order of 2 pCi/g Ra-226. Onsite samples ranged from about 1 to 21,000 pCi/g Ra-226, and from less than 10 to 2100 pCi/g U-238. In those cases where elevated levels of Ra-226 were detected, the concentrations of U-238 were generally anywhere from a factor of 2 to 10 lower. In cases of elevated sample activity, daughter products of both U-238 and U-235 were found.

In general, surface activity was limited to Area 2, as indicated by surface beta-gamma measurements. Only two small regions in Area 1 showed contamination; both were near the access road across from the site offices.

In addition to onsite gamma analyses, 12 samples were submitted to RMC's radiochemical laboratories for thorium and uranium radiochemical determinations. The results show all samples contain high levels of Th-230. The ratio of Th-230 to Ra-226 (Bi-214) is about 20 to 1.

Subsurface Soil Analysis

Subsurface contamination was assessed by extensively "logging" holes drilled through the landfill. Several holes were drilled in areas known to contain contamination, then additional holes were drilled at intervals in all directions until no further contamination was encountered. A total of 43 holes were drilled, 11 in Area 1 and, in Area 2, 32 including 2 nearby offsite wells for monitoring water. All holes were drilled with a 6-in. auger and lined with 4-in. PVC (polyvinyl chloride) casing. The location of these auger holes is shown in Figures 3.4 and 3.5.

Each hole was scanned with an NaI(Tl) detector and rate meter system for an initial indication of the location of subsurface contamination. On the basis of the initial scans, 19 holes were selected for detailed gamma logging using the intrinsic germanium (IG) detector and multiple channel analyzer.

The results of the NaI(Tl) counts and IG analyses show concentrations of Bi-214, as determined by the IG system, ranged from less than 1 to 19,000 pCi/g. For those holes where both NaI(Tl) counts and IG counts were made, a good correlation between gross NaI(Tl) counts and Ra-226 concentrations, as determined by in situ analysis of the daughter Bi-214 by the IG system, was found.

It was determined that the subsurface deposits extended beyond areas where surface radiation measurements exceeded 5 pCi/g. The approximate area of subsurface contamination compared to the area of elevated surface radiation levels shows a total difference in areas of 2 ha (5 acres).

The variations of contamination with depth for Areas 1 and 2 are shown in Figure 3.6. As can be seen, the surface elevations vary by about 6 m (20 ft), and the highest elevations occur at locations of fresh fill. Contamination (>5 pCi/g Ra-226) in several areas is found to extend from the surface to appreciable depths, about 6 m (20 ft) below the surface in two cases. In general, the subsurface contamination appears to be a continuous single layer, ranging from 0.6 to 4.6 m (2 to 15 ft) thick, located between elevations of 139 to 144 m (455 to 480 ft) and covering 6.5 ha (16 acres) total area.

In Figures 3.7 and 3.8, representations of the subsurface deposits are provided on the basis of auger hole measurements. These representations are consistent with the operating history of the site, which suggests that the contaminated material was moved onto the site and spread as cover over fill material. Thus, * one would expect a fairly continuous, thin layer of contamination, as indicated by survey results.

Nonradiological Analysis

Six composite samples were submitted to RMC's Environmental Chemistry Laboratory for priority pollutant analysis. Five samples were taken from auger holes (one from Area 1 and four from Area 2) and the sixth from the West Lake leachate treatment plant sludge. The results indicate a significant presence of organic solvents in Area 2 samples. The results of the leachate sludge analysis were not as high as any of the soil samples.

A chemical analysis of radioactive material from both areas was also performed by RMC's laboratory. Results show elevated levels of barium and lead in most cases.

Background Radioactivity Measurement

Various offsite locations were selected for reference background measurements. The results of these measurements were within the normal range.

Airborne Radioactivity Analyses

Both gaseous and particulate airborne radioactivity were sampled and analyzed during this study. Since it was known that the buried material consisted partially or totally of uranium ore residues, the sampling program concentrated on measuring radon and its daughters in the air. Two methods were used: the first was a scintillation flask method for radon gas and the second was analysis of filter paper activity for particulate daughters.

A series of grab samples using the accumulator method were taken between May and August of 1981. A total of 111 samples from 32 locations was collected. Measurable radon flux levels ranged from 0.2 pCi/m^{2}s in low background areas to 865 pCi/m^{2}s in areas of surface contamination.

At three locations, repetitive measurements were made over a period of 2 months. These results are plotted in Figure 3.9. As can be seen, significant fluctuations were observed at two locations. The fact that these fluctuations were real and not measurement artifacts was later confirmed by duplicate charcoal canister samples, as described below.

A total of 35 charcoal canister samples was gathered at 19 locations over a 3-month period. The results show levels ranging from 0.3 pCi/m^{2}s to 613 pCi/m^{2}s. On 24 different occasions, the charcoal canisters and accumulator were placed in essentially the same locations, at the same time, for duplicate sampling. The results of this side-by-side study show generally good correlation between the two methods.

A set of 10-minute high-volume particulate air samples was taken to determine both short-lived radon daughter concentrations and long-lived gross alpha activity. The highest levels were detected in November 1980, near and inside the Butler-type building which has since been removed. These two samples approximately equal NRC's 10 CFR Part 20, Appendix B, alternate concentration limit of one-thirtieth WL for unrestricted areas. *

In addition to the routine 10-minute samples, five 20-minute high-volume air samples were taken and counted immediately on the IG gamma spectroscopy system to detect the presence of Rn-219 daughters. All samples were taken near surface contamination. In addition to Rn-222 daughter gamma activities, Rn-219 daughters were detected by measuring the low-abundance gamma rays of Pb-211. Concentrations of Rn-219 daughters ranged from 6×10^{-11} to 9×10^{-10} µCi/cc.

Vegetation Analysis

Vegetation samples included weed samples from onsite locations and farm crop samples (winter wheat) near the northwest boundary of the landfill. This location was chosen because runoff from the fill onto the farm field was possible. No elevated activities were found in these samples. *

Water Analyses

A total of 37 water samples was taken: 4 in the fall of 1980, and the remainder in the spring and summer of 1981. One sample was equal to the U.S. Environmental Protection Agency (EPA) gross alpha activity standard for drinking water of 15 pCi/liter and that was a sample of standing water near the Butler-type building. Several samples, including all the leachate treatment plant samples, exceeded the EPA drinking water screening level for gross beta which would require isotopic analyses. Subsequent isotopic analyses indicated that the beta activity could be attributed to K-40. None of the offsite samples exceeded either EPA standard or screening level. *

In 1981, MDNR collected 41 water samples which RMC analyzed for radioactivity (Table 3.1). Of these samples, 5 were background, 10 were onsite surface water, 10 were shallow groundwater standing in boreholes, and 16 were landfill leachate. From these data, background activity is estimated as 1.2 pCi/liter gross alpha and 27 pCi/liter gross beta. Results in Table 3.1 show the gross alpha in two water samples exceeded or equaled 15 pCi/l; the gross beta in ten water samples exceeded 50 pCi/l. Most of the gross beta activity comes from ? naturally occurring K-40 as determined from subsequent isotopic analysis.

In addition, groundwater samples in perimeter monitoring wells at the West Lake Landfill were taken by UMC personnel and ORAU in 1983, 1984, and 1986. The well locations are shown in Figure 2.5 and the results are presented in

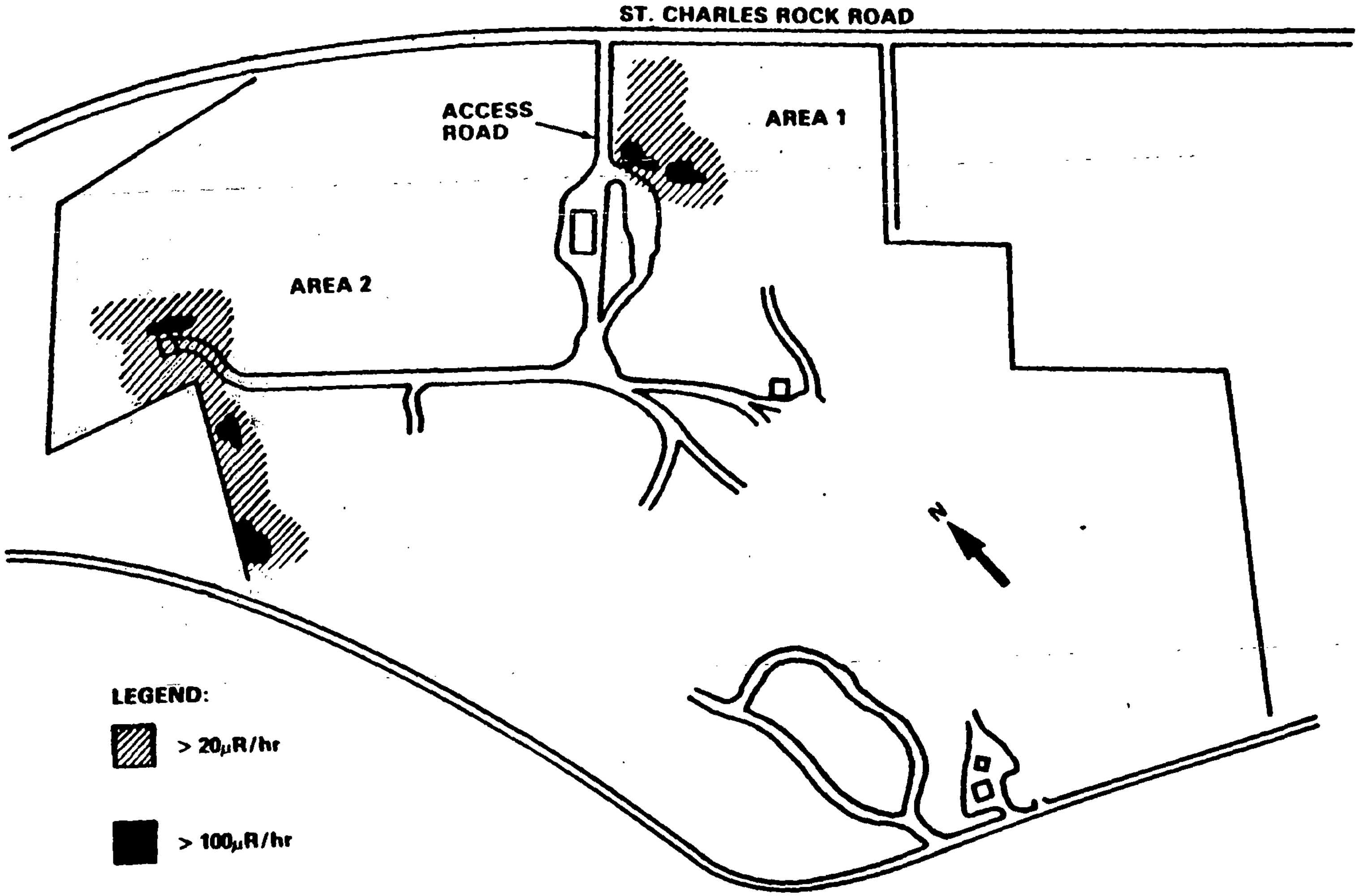
Tables 3.2 and 3.3. Results in Table 3.2 show the gross alpha in two water samples slightly exceeded 15 pCi/l; the gross beta were all below 50 pCi/l in all water samples. Table 3.3 shows analyses were below 15 pCi/l for gross alpha and 50 pCi/l for gross beta for all the wells.

3.3 Estimation of Radioactivity Inventory

In examining the RMC report for bore hole samples (Table 3.3), it is noted that the naturally occurring U-238 to Th-230 to Ra-226 equilibrium has been disturbed. The RMC report (NRC, NUREG/CR-2722) indicates that the ratio of Ra-226 to U-238 is on the order of 2:1 to 10:1. This observation is consistent with the history of the radionuclide deposits in the West Lake Landfill, i.e., that they came from the processing of uranium ores to extract the uranium content and that the radioactive material at West Lake came from the former Cotter Corporation facility on Latty Avenue (presently occupied by Futura Coatings Company) in Hazelwood, Missouri. This location contains contamination from ore processing residues from which uranium had been previously separated, leaving the daughters behind at relatively higher concentrations. Additionally, it is noted in the RMC report that the ratio of Th-230 to Ra-226 is on the order of 5:1 to 50:1. * This indicates that radium has also been removed. Other data are available in the Latty Avenue site study (Cole, 1981). Table 3.4 presents the radionuclide concentrations in Latty Avenue composite samples.

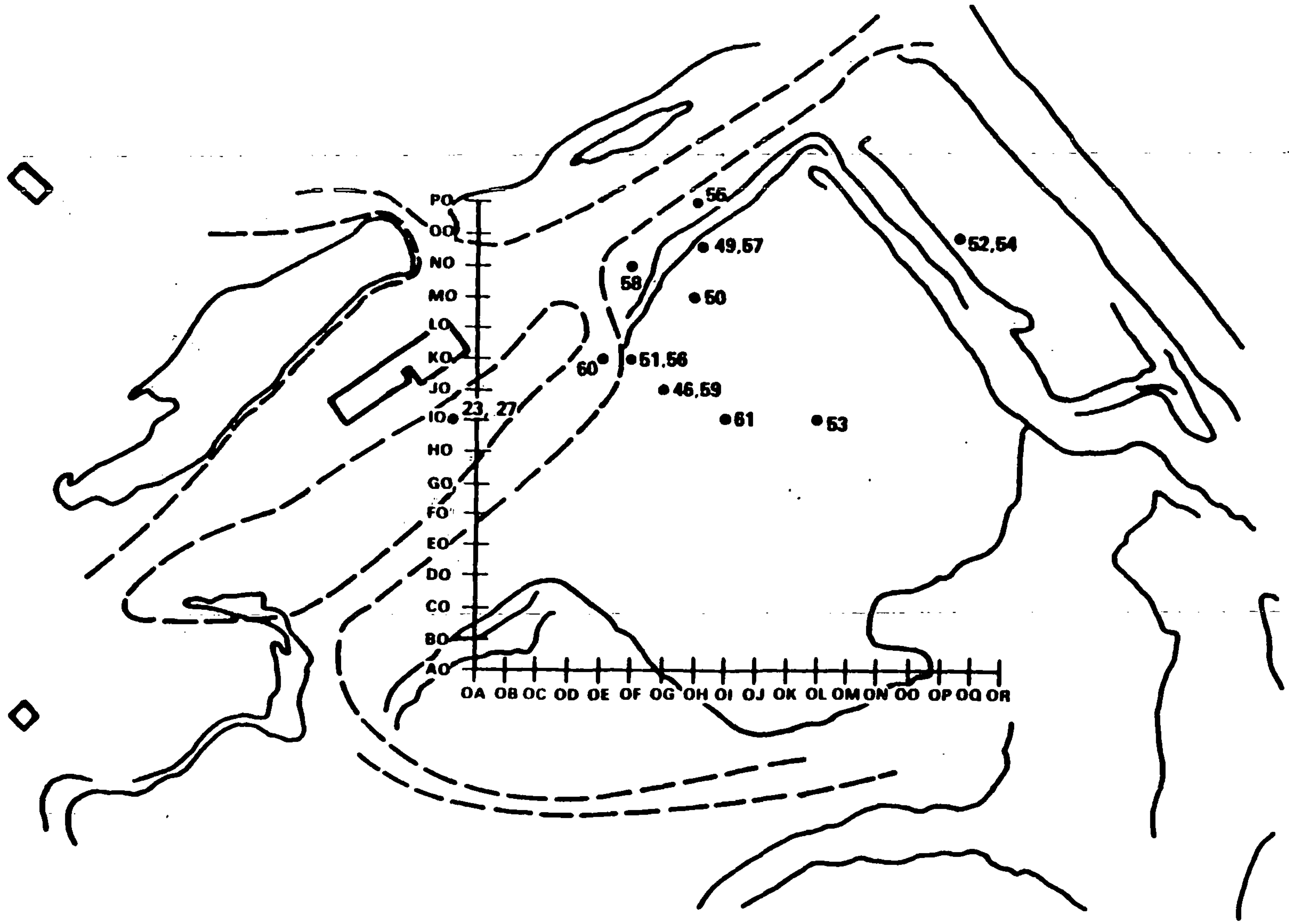
Using the RMC data and averaging the auger hole measurements over the two volumes of radioactive material found in Areas 1 and 2, a mean concentration of 90 pCi/g was calculated for Ra-226. Also, the ratios of Th-230 to Ra-226 were established since the level of Th-230 will determine the increase of Ra-226 with time. Although the ratio of Th-230 to Ra-226 ranged from 5:1 to 150:1, most of the data were in the 30:1 to 50:1 range. To ensure conservatism in estimating the long-term effects of Ra-226, a ratio of 100:1 was used for all further calculations.

Using the Th-230:Ra-226 ratio of 100:1, the Th-230 activity is 9000 pCi per gram. If the U-238 concentration (as well as U-234 which would be similarly separated from the ore) is a factor of 5 less than Ra-226, this implies about 18 pCi U-238 per gram. The total mass of radioactive material (having Ra-226 concentrations of 5 pCi/g or more) in the landfill was estimated by visually integrating the volume of radioactive material from graphs and multiplying by an average soil density, resulting in 1.5×10^{11} grams (150,000 metric tons) of contaminated soil. These numbers indicate that there are about 14 Ci of Ra-226 contained with its decay products in the radioactive material in the landfill. The material also contains about 3 Ci each of U-238 and U-234, and about 1400 Ci of Th-230. These estimates indicate the order of magnitude of the quantities to be dealt with, although the estimate for Th-230 is regarded as conservatively large.



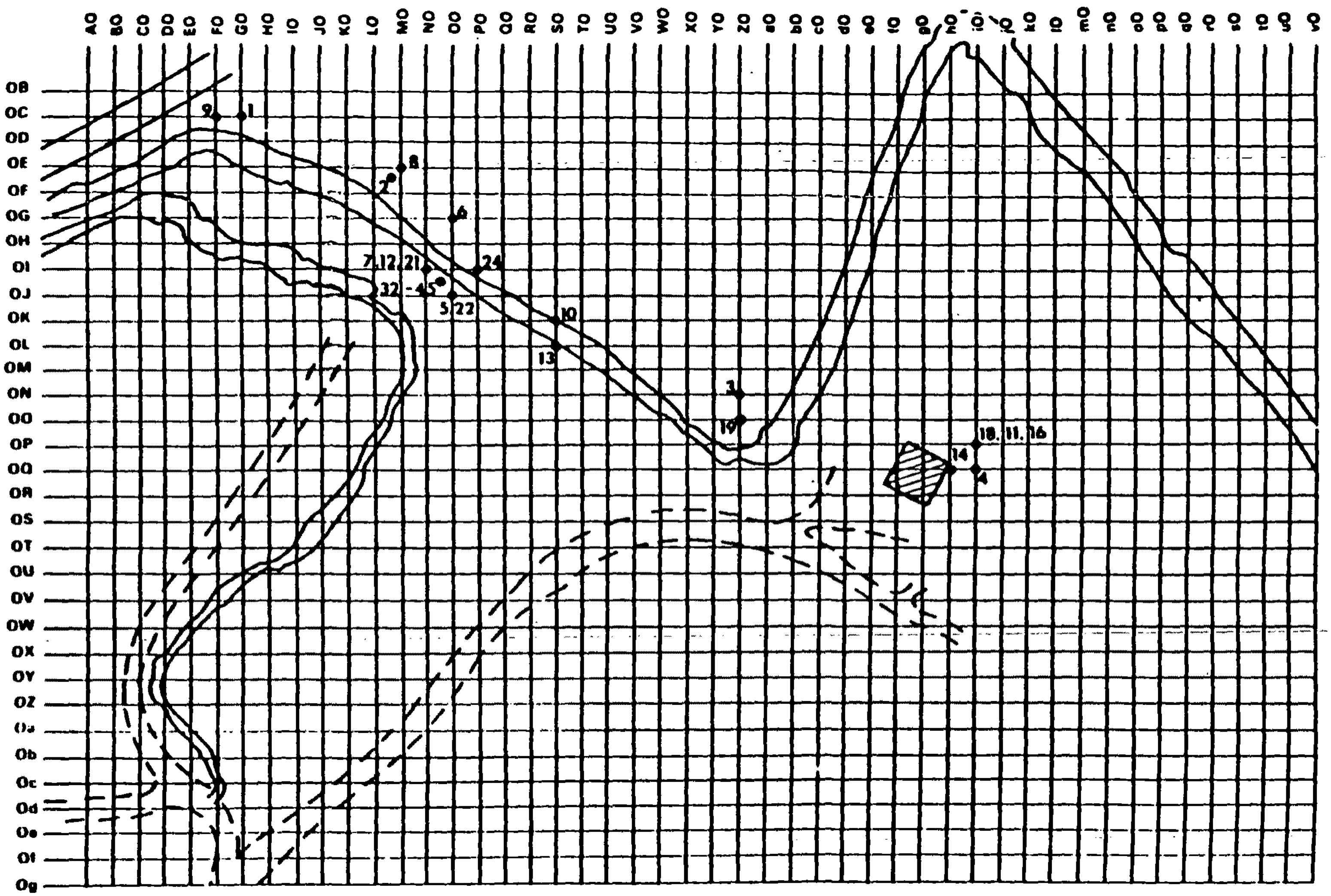
Source: NUREG/CR-2722, Figure 3, p. 27.

Figure 3.1 External gamma radiation levels (November 1980)



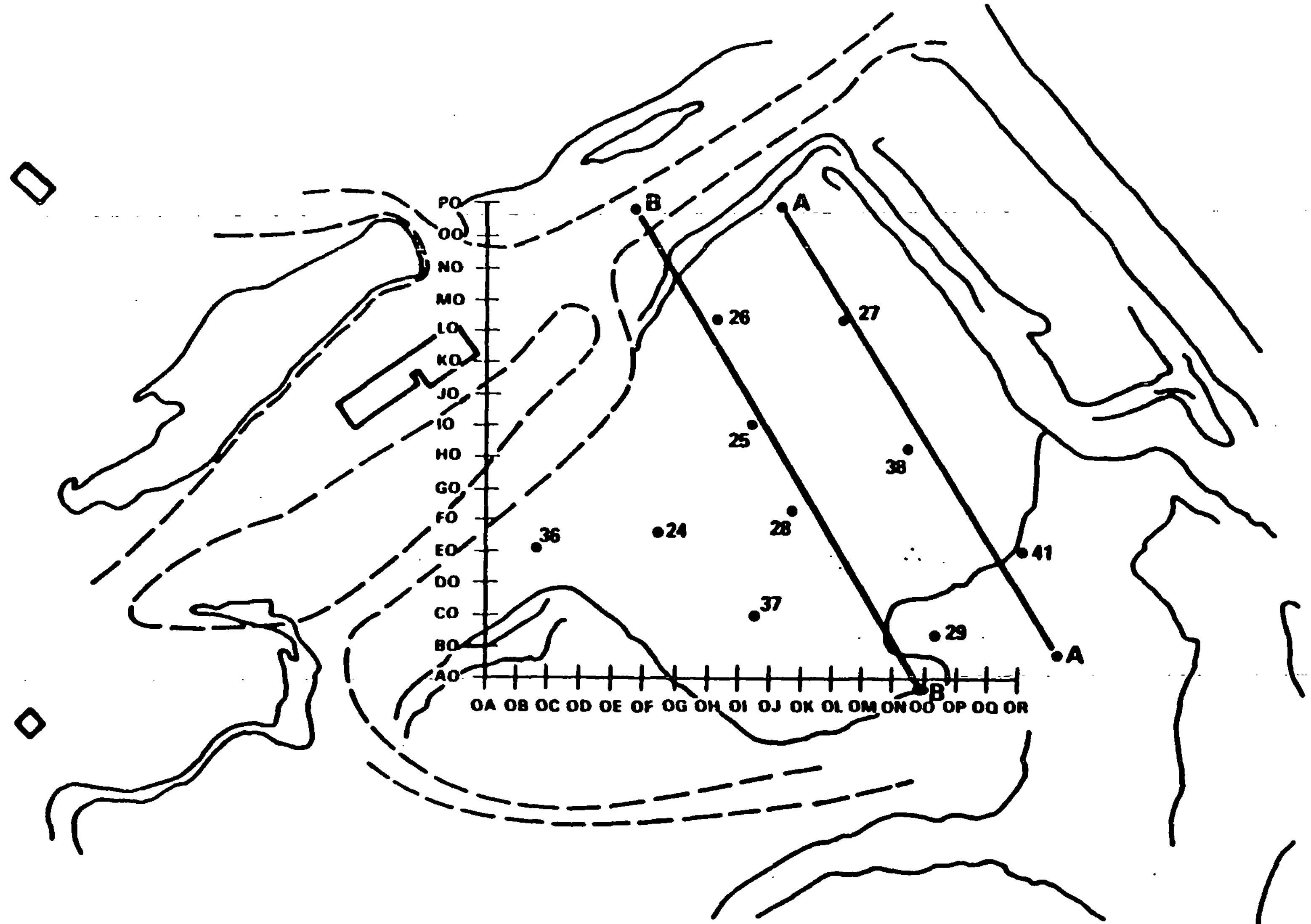
Source: NUREG/CR-2722, Figure 7, p. 31.

Figure 3.2 Location of surface soil samples, Area 1



Source: NUREG/CR-2722, Figure 8, p. 32.

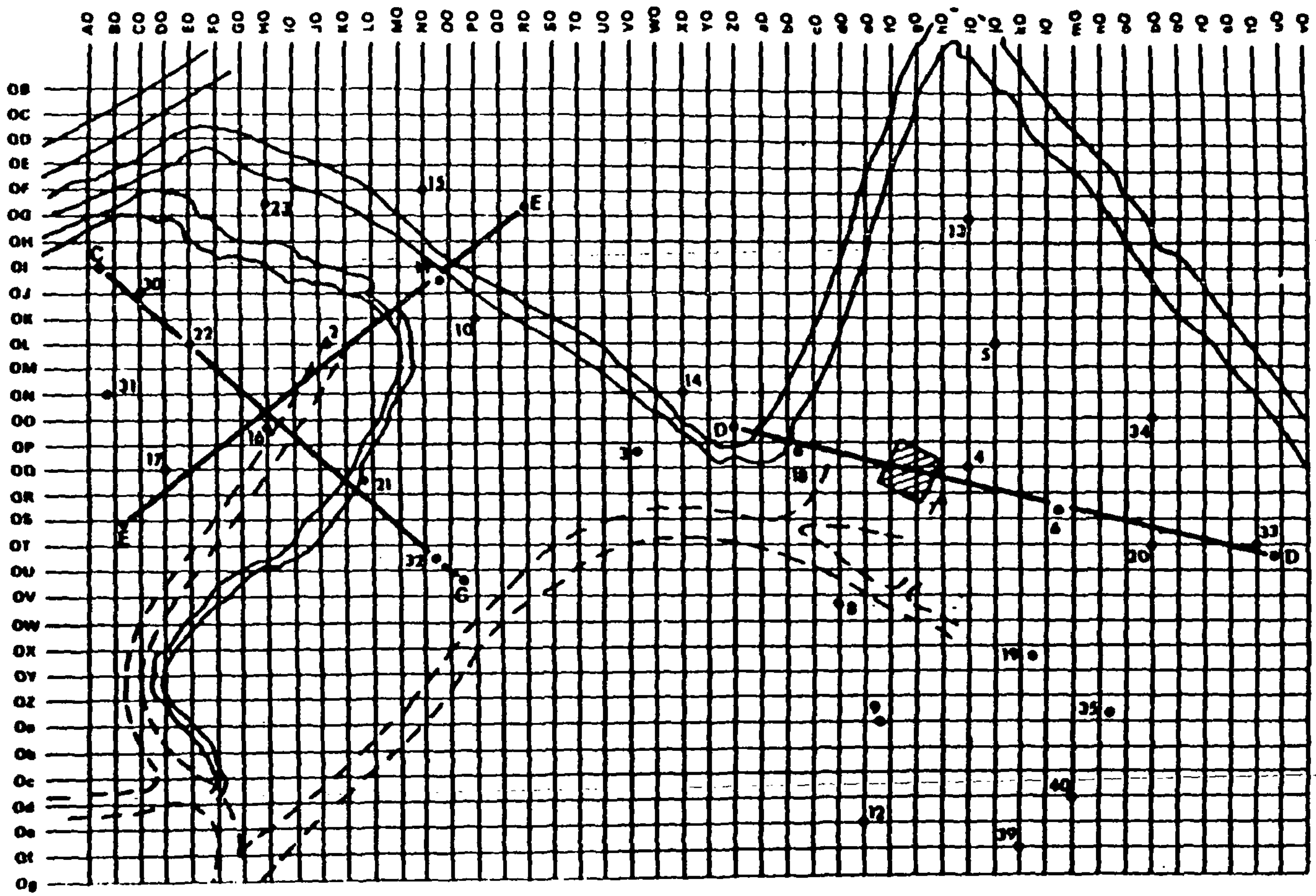
Figure 3.3 Location of surface soil samples, Area 2



Note: Line B-B indicates cross-sectional area shown in Figure 3.7.

Source: NUREG/CR-2722, Figure 9, p. 33.

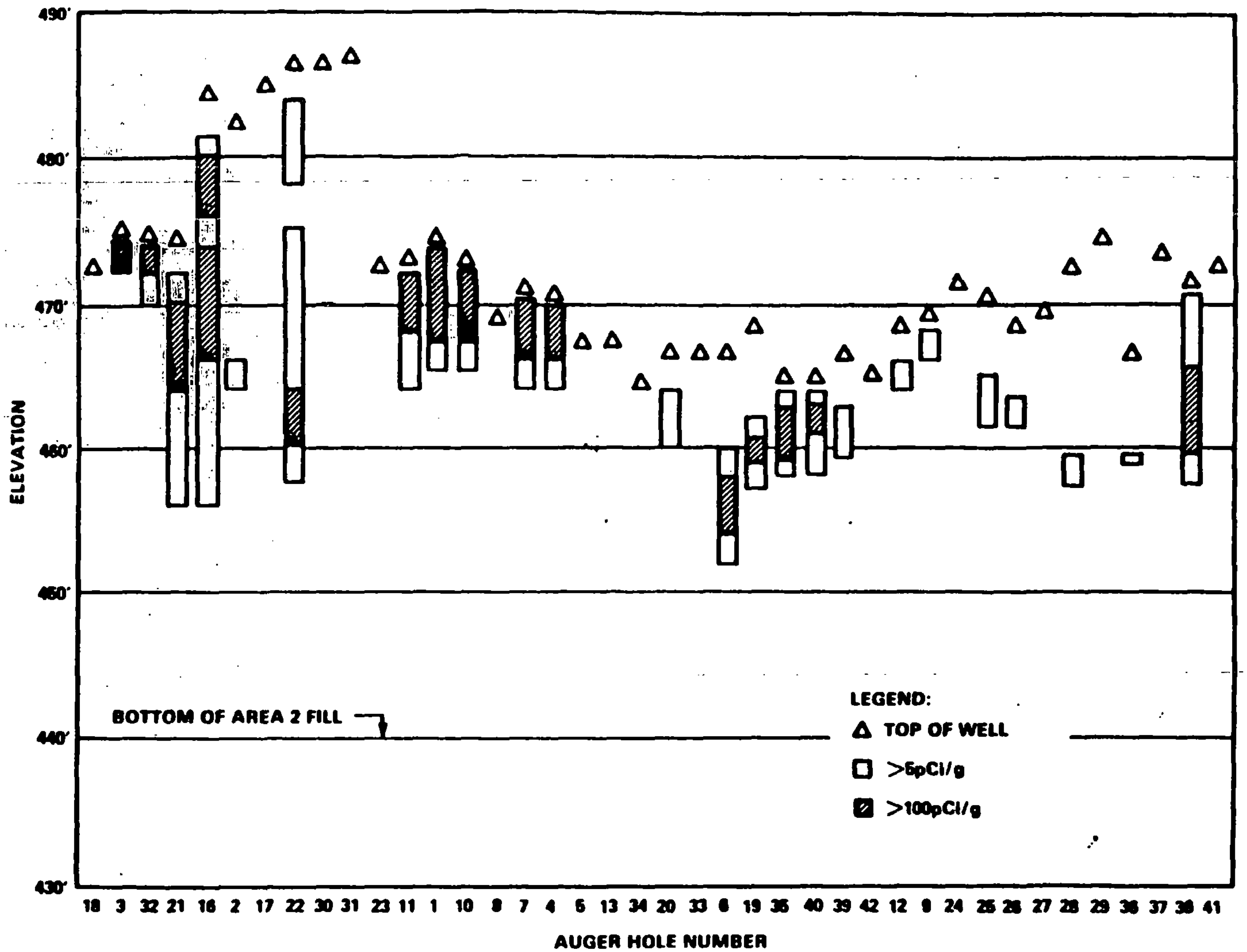
Figure 3.4 Location of auger holes, Area 1



Note: Line E-E indicates cross-sectional area shown in Figure 3.8.

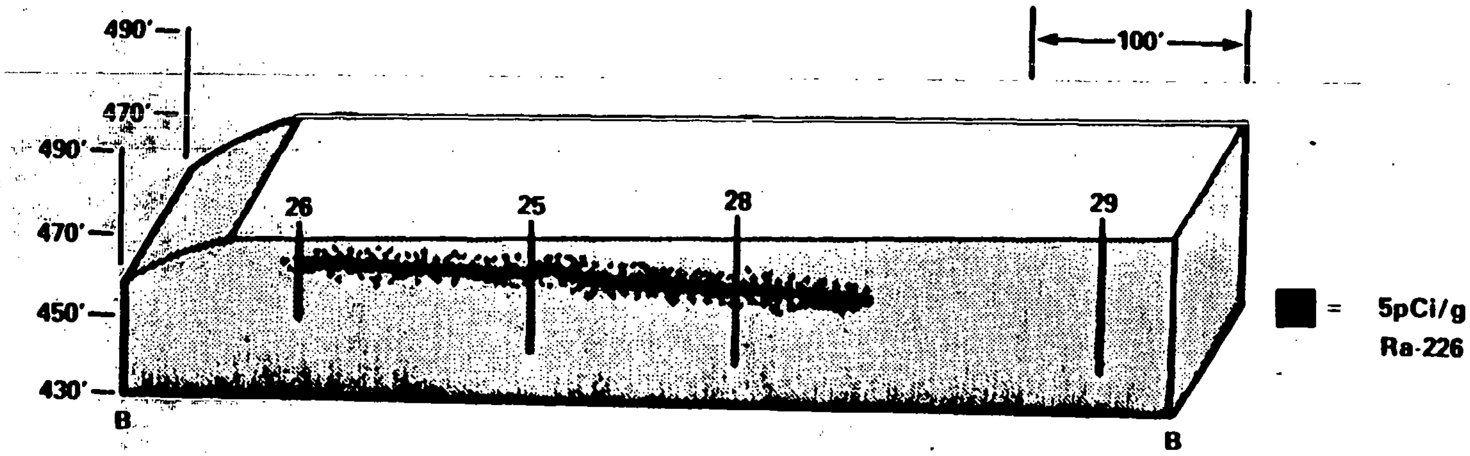
Source: NUREG/CR-2722, Figure 10, p. 34.

Figure 3.5 Location of auger holes, Area 2



Source: NUREG/CR-2722, Figure 14, p. 38.

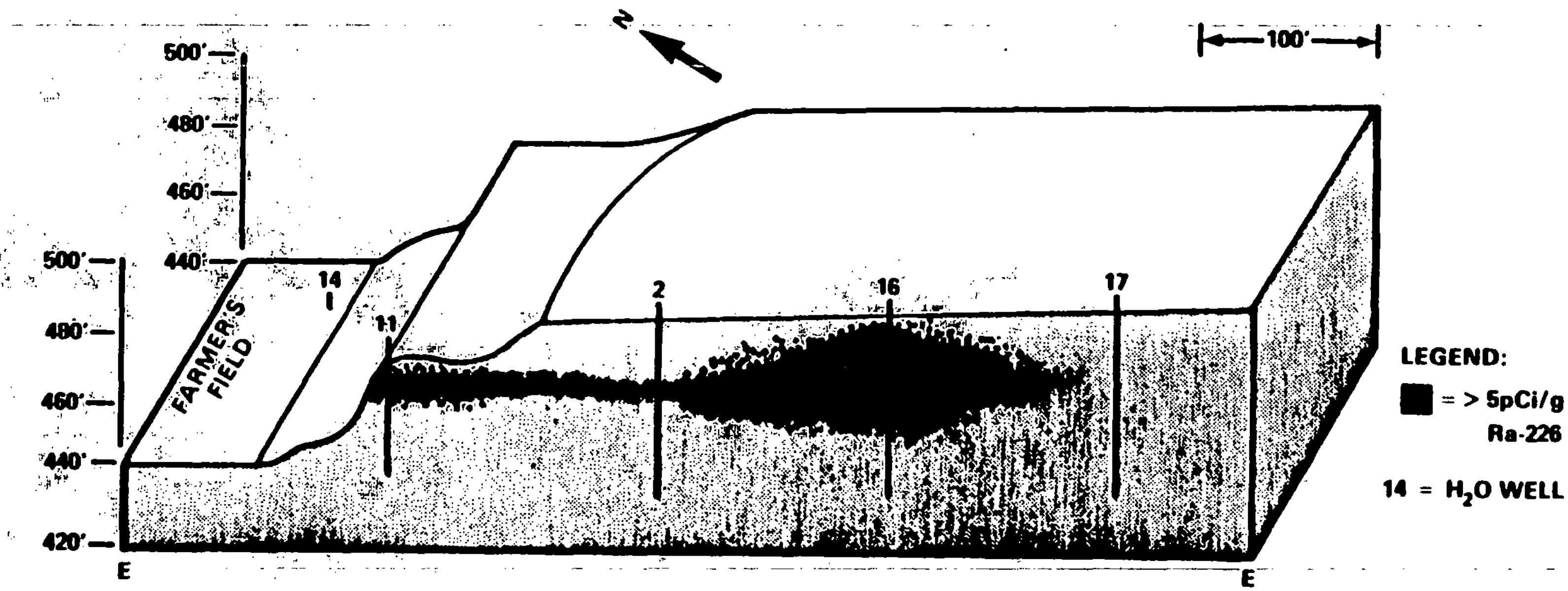
Figure 3.6 Auger hole elevations and location of contamination within each hole



Notes: (1) B-B is defined in Figure 3.4.
(2) The blackened areas indicate the estimated extent of contamination exceeding 5 pCi/g Ra-226, based on surface and auger hole measurements.

Source: NUREG/CR-2722, Figure 16, p. 39.

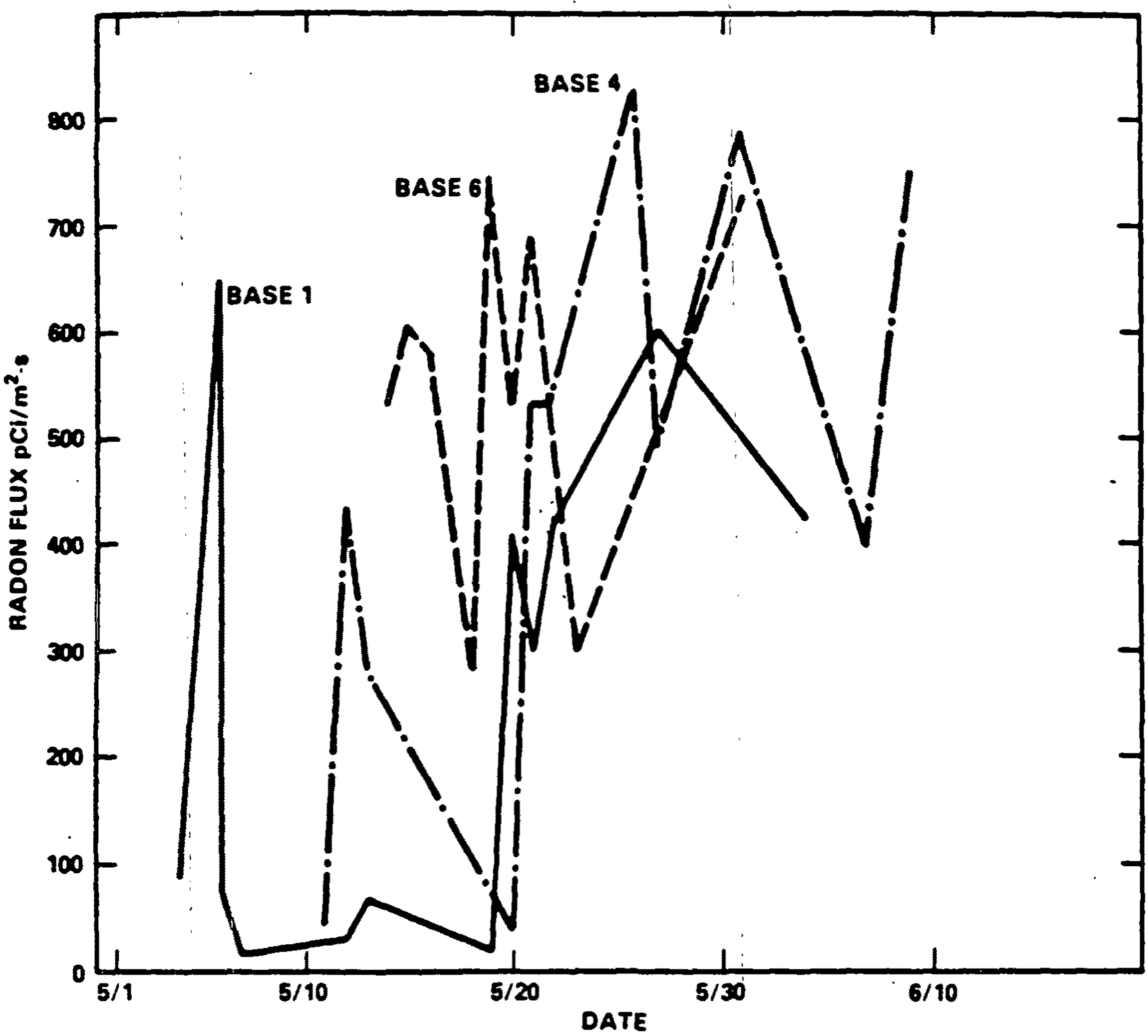
Figure 3.7 Cross-section B-B showing subsurface deposits in Area 1



Notes: (1) E-E is defined in Figure 3.5.
(2) The blackened areas indicate the estimated extent of contamination exceeding 5 pCi/g Ra-226, based on surface and auger hole measurements.

Source: NUREG/CR-2722, Figure 19, p. 42.

Figure 3.8 Cross-section E-E showing subsurface deposits in Area 2



Source: NUREG/CR-2722, Figure 20, p. 43.

Figure 3.9 Rn-222 flux measurements at three locations in Area 2 (1981)

Table 3.1 RMC radionuclide analyses of water samples from the West Lake site taken by MDNR in 1981

Sample #	Type of sample*	Gross alpha (pCi/l)	Gross beta (pCi/l)
7001	S	3.11	22.5
7002	S	8.00	23.4
7003	S	1.56	9.88
7019	S	1.91	30.0
7025	S	1.56	36.5
7028	S	45.2	87.8
7029	S	<0.64	<1.34
7030	S	0.52	35.1
7031	S	1.43	26.3
7004	B	1.04	19.7
7021	B	1.56	29.1
7027	B	1.04	32.5
7032	B	<0.05	26.3
7033	B	1.04	29.0
7009	G	4.50	22.3
7010	G	2.60	15.2
7011	G	3.12	10.6
7012	G	7.10	16.6
7017	G	0.52	33.6
7018	G	6.76	36.1
7020	G	8.84	30.1
7026	G	<2.0	38.9
2	G	15.0	41.0
3	G	2.9	7.6

See footnote at end of table.

Table 3.1 (Continued)

Sample #	Type of sample*	Gross alpha (pCi/l)	Gross beta (pCi/l)
7013	L	<3.0	1.30
7014	L	<3.0	130
7015	L	<3.0	103
7016	L	<3.0	98.9
7022	L	3.45	107
7023	L	<3.0	122
7024	L	<3.0	86.7
7034	L	<3.0	10.3
7035	L	<3.0	84.5
7036	L	<3.0	69.6
1	L	7.3	80
4	L	<3.0	26

Sample #	Type of sample*	Ra-226 (pCi/l)	K-40 (pCi/l)
7014	L	<1.6	138
7015	L	3.9	136
7016	L	<1.6	98.9
7022	L	2.4	104
7028	S	1.6	124

*S = surface sample
B = offsite, background
G = groundwater from boreholes
L = leachate

Table 3.2 Radiological quality of water in perimeter monitoring wells of West Lake Landfill (concentrations reported in pCi/l)

Well #	Ra-226	Gross alpha*	Gross beta*	Gross alpha**	Gross beta**
18	-	-	-	12.5	12.5
59	<3	3.2	9.9	-	-
60	-	-	-	20.5	20.8
61	-	-	-	2.7	13.9
62	<3	2.8	7.4	3.5	8.5
63	-	-	-	2.2	7.0
65	<3	12.4	33.1	5.7	6.3
66	<3	4.3	6.9	-	-
67	<3	5	5.3	-	-
68	<3	18.2	18.8	-	-
50***	<3	5	7.7	1.3	8.1

*Samples taken November 15, 1983.
**Samples taken March 21, 1984, by UMC personnel, analyzed by Environmental Health Lab of St. Louis County Health Department, Clayton, Missouri.
***Well #50 used as background.

Table 3.3 Radionuclide concentrations in well water samples: May 7-8, 1986

Radionuclide	Concentrations (pCi/l)						
	Well 50[a]	Well 51	Well 52	Well 53	Well 54	Well 55	Well 56
Gross alpha	2.2	2.2	1.9	11	4.4	4.8	5.7
Gross beta	7.5	4.4	7.5	16	14	14	12
Ra-226	--[b]	--	--	0.4	--	--	0.2
Ra-228	--	--	--	1.7	--	--	0.3
U-total	--	--	--	22	--	--	8.9
Th-228	--	--	--	0.5	--	--	0.3
Th-230	--	--	--	0.9	--	--	0.9
Th-232	--	--	--	0.3	--	--	0.8
Depth to water (m)	5.0	3.8	3.2	3.3	15.5	11.5	11.5

Table 3.3 (Continued)

Radionuclide	Concentrations (pCi/l)						
	Well 58	Well 59	Well 60	Well 61	Well 62	Well 65	Well 66
Gross alpha	5.8	11	14	3.3	5.6	3.5	1.8
Gross beta	15	46	19	14	10	7.4	9.9
Ra-226	0.3	0.3	2.5	--	0.8	--	--
Ra-228	2.9	0.5	1.6	--	0.6	--	--
U-total	13	25	19	--	2.3	--	--
Th-228	0.6	0.5	0.5	--	0.8	--	--
Th-230	1.5	0.2	4.4	--	1.2	--	--
Th-232	0.7	0.1	0.1	--	0.6	--	--
Depth to water (m)	14.0	Not determined	3.5	4.5	4.2	1.9	1.9

Table 3.3 (Continued)

Radionuclide	Concentrations (pCi/l)						
	Well 67	Well 68	Well 72	Well 73	Well 75	Well 76	Well 80
Gross alpha	8.4	0.9	1.4	6.5	11	3.6	0.4
Gross beta	7.1	1.9	4.6	7.7	22	6.9	3.2
Ra-226	0.7			0.3	--	--	--
Ra-228	0.3			0.9	--	--	--
U-total	7.4			3.1	16	--	2.2
Th-228	0.9			1.7	0.6	--	0.3
Th-230	9.9			6.7	12	--	0.0
Th-232	0.2			0.2	0.2	--	0.1
Depth to water (m)	1.5	4.4	10.0	8.4	7.6	13.8	5.3

Table 3.3 (Continued)

Radionuclide	Concentrations (pCi/l)						
	Well 81	Well 82	Well 83	Well 84	Well 87	Well 88	Well 89
Gross alpha	7.9	17	9.0	13	1.5	11	3.7
Gross beta	16	47	18	27	7.2	18	9.1
Ra-226	0.8	0.3	3.4	1.7	--	2.3	--
Ra-228	0.4	0.4	4.6	5.8	--	0.2	--
U-total	4.9	13	1.6	9.0	--	3.0	--
Th-228	0.9	0.4	0.2	0.6	--	1.1	--
Th-230	0.9	1.8	0.4	1.3	--	1.5	--
Th-232	0.3	0.3	1.0	1.1	--	4.0	--
Depth to water (m)	4.8	5.1	3.9	7.0	9.4	8.6	7.5

Table 3.3 (Continued)

Radionuclide	Well 90	Well 92	Well 93	Well 94
	Concentrations (pCi/l)			
Gross alpha	2.2	7.3	7.4	1.6
Gross beta	6.8	11	22	9.9
Ra-226	--	1.0	1.6	
Ra-228	--	0.8	1.4	
U-total	--	17	6.0	
Th-228	--	0.5	0.8	
Th-230	--	0.1	0.7	
Th-232	--	0.4	1.6	
Depth to water (m)	4.1	13.1	4.7	2.1

[a] Refer to Figure 2.5 for well location.

[b] Dash indicates analysis not performed.

Table 3.4 Radionuclide concentrations in Latty Avenue composite samples

	Concentrations (pCi/gm)								
Sample	U-235	U-238	Th-232*	Th-230	Th-228	Ra-226	Ra-228	Pa-231	Ac-227
Composite 1	3.6 ± 0.3**	82 ± 8	2.3 ± 0.6	8770 ± 100	2.1 ± 0.5	64 ± 1	2.3 ± 0.6	114 ± 2	205 ± 2
Composite 2	4.4 ± 0.3	62 ± 15	1.5 ± 0.5	8950 ± 370	2.0 ± 0.5	50 ± 1	1.5 ± 0.5	117 ± 8	Not Performed
Average	4.0 ± 0.2	72 ± 9	1.9 ± 0.4	8860 ± 190	2.1 ± 0.3	57 ± 1	1.9 ± 0.4	116 ± 4	205 ± 2

*Based on Ra-228 and assumption of secular equilibrium of thorium decay series.
**Errors are 2σ based only on counting statistics.

Source: Table 2 (Cole, 1981).

4 APPLICABILITY OF THE BRANCH TECHNICAL POSITION

The NRC has established a Branch Technical Position (BTP) which identifies five acceptable options for disposal or onsite storage of wastes containing low levels of uranium and thorium (46 FR 52061, October 23, 1981). Options 1-4 provide methods under 10 CFR 20.302, for onsite disposal of slightly contaminated materials, e.g., soil, if the concentrations of radioactivity are small enough and other circumstances are satisfactory. The fifth option consists of onsite storage pending availability of an appropriate disposal method. Table 4.1 shows the radionuclide concentrations specified for the disposal options. **

The material present in the West Lake Landfill is a form of natural uranium with daughters, although the daughters are not now in equilibrium. As mentioned above, the average concentration of Ra-226 in the West Lake Landfill wastes is about 90 pCi per gram, which (considered by itself) falls into Option 4 of the BTP since Option 4 criteria are controlled by the Ra-226 content in the wastes (i.e., 200 pCi of U-238 plus U-234 per gram would be accompanied by 100 pCi of Ra-226 per gram). However, because of the large ratio of Th-230 radioactivity to that of Ra-226, the radioactive decay of the Th-230 will increase the concentration of its decay product Ra-226 until these two radionuclides are again in equilibrium. Assuming the ratio of activities of 100:1 used above, the Ra-226 activity will increase by a factor of five over the next 100 years, by a factor of nine 200 years from now, and by a factor of thirty-five 1000 years from now. All radionuclides in the decay chain after Ra-226 (and thus the Rn-222 gas flux) will also be increased by similar multiples. Therefore, the long-term Ra-226 concentration will exceed the Option 4 criteria. *

Table 4.1 Summary of maximum soil concentrations permitted under disposal options

Source: 46 Federal Register 52061

Kind of material	Disposal options			
	1[a]	2[b]	3[c]	4[d]
Natural thorium (Th-232 + Th-228) with daughters present and in equilibrium. (pCi/g)	10	50	-	500
Natural uranium (U-238 + U-234) with daughters present and in equilibrium. (pCi/g)	10	-	40	200

[a]Based on EPA uranium mill tailings cleanup standards.

[b]Concentrations based on limiting individual intruder doses to 170 mrem per year.

[c]Concentration based on limiting equivalent exposure to 0.02 WL or less.

[d]Concentrations based on limiting individual intruder doses to 500 mrem per year and, in cases of natural uranium, limiting exposure to Rn-222 and its decay product airborne alpha emitters to 0.02 WL or less.

5 REMEDIAL ACTION ALTERNATIVE CONSIDERATIONS

The radioactive material as it presently exists does not pose an immediate health hazard for individuals living or working in the area of the landfill. However, there is a long-term potential for the radioactive material to pose a health problem. Therefore, this section discusses six (A-F) possible courses of action, of which all but A and D are considered temporary. Option A, in which no remedial action is proposed, is unacceptable because the concentrations of radionuclides in the landfill will become too high; Option A is described for comparison purposes only. Costs are based on the Dodge Guide to Public Works and Heavy Construction, 1984.

5.1 Option A: No Remedial Action

Under Option A, no remedial work would be done on the West Lake site. The landfill and the radioactive soil would be left in their present condition. The contaminated areas would be available for demolition fill emplacement and final closure. It is not certain how much additional fill would be emplaced. Filling would be followed by normal landfill closure operations.

Normal closure procedures consist of applying at least 0.61 m (2 ft) of compacted final cover. A 0.3-m (1 ft) layer of topsoil would be placed over the cover and upgraded to support vegetation. Establishment of a vegetative cover would require seeding, liming, and fertilization. Surface seeps of leachate would be eliminated. Maintenance of the monitoring wells would be required to allow continued sampling by MDNR, should MDNR require such action. The public would be discouraged from entering the site. After closure, a detailed description of the site would be filed with the County Recorder of Deeds. This description would include: a legal description of the site, types and location of wastes present, depth of fill, and description of any environmental control or monitoring systems requiring future maintenance (MDNR, January 1983). MDNR regulations also specifically prohibit excavation or disruption of the closed landfill without written approval of MDNR; no time frame is stated with this regulation (MDNR, 1975).

There would be no further cost under this option since no remedial actions would be taken; i.e., costs are normal landfill costs.

5.2 Option B: Stabilization on Site With Restricted Land Use

Two areas in the landfill contain radioactive material. Therefore, the work required for this option is described separately for each area. Nevertheless, restrictions would be imposed on the use of land within each area. This would discourage future activities on these areas which might expose individuals to radioactivity. No additional landfill would be permitted to be deposited on either area.

Area 1

It is believed that a total of 2 to 3 m (7 to 10 ft) of soil has been added to most of Area 1 since the 1981 land survey by RMC. This cover has altered the radiation environment of the site. Measurements by Oak Ridge Associated Universities (ORAU) personnel in March 1984 (Berger) showed that only a very small area exceeded the exposure rate of 20 μR/hr at 1 m. By extending the cover 20 m (66 ft) outward in all directions from the area showing an unacceptable surface exposure rate, the shallow wastes likely to give high rates of radon emanation will also be covered. The amount of radioactive debris in Area 1 is relatively minor compared with that present in Area 2. Therefore, a soil cover of 1.5 m (5 ft) is considered adequate to reduce surface exposure rates and radon emanation. After the soil cover is in place, a layer of topsoil 0.3 m (1 ft) thick would be emplaced, seeded, and mulched.

Area 2

Vegetation over Area 2 as well as on the slope of the berm would be cleared and placed in the demolition portion of the landfill or disposed of as is convenient. Brush should not be left in place and covered since this may reduce the integrity of the soil cap. Grass should be mowed, and may be left in place.

The berm on the northwest portion of the landfill which contains an estimated 7,500 m^3 (9,800 yd^3) of contaminated soil would be excavated and redeposited in layers in a secure portion of the landfill. The actual amount can be determined by survey during implementation of the work.

All equipment and materials now stored over Area 2 would be removed to other portions of the site or disposed of as is convenient to the owners. Gravel piles found on Area 2 should be removed to other portions of the site after having been surveyed to ensure that contaminants have not been mixed with the gravel. However, the lower 10 to 15 cm (4 to 6 in.) of rock should be left in place and covered with the soil cap, since this gravel may have become mixed with contaminated soil.

Such stabilization would place the contaminated soil well below the surface and would prevent radioactive materials from eroding as can now occur along sections of the berm. Stabilization would require emplacement of a soil cover of 48,000 m^3 (63,000 yd^3) to give a final slope of 3:1 with 1.5 m (5 ft) of soil at the top of the berm. At least 1.5 m (5 ft) of soil cover would be used, as this much soil will be required to reduce radon gas exhalation. The final slope of 3:1 on the berm would be shallow enough to prevent failure and, after the cover is emplaced, it should be further covered with at least 0.3 m (1 ft) of topsoil and seeded with native grasses to prevent erosion. The slope would be directed radially outward from the center of the cap. An interceptor ditch would be provided around the cap to channel runoff and prevent gullies from being cut into the stabilized cover. The cover soil presently used in the landfilling operations may be used to stabilize the berm. This soil is a clay silt (loess) excavated near the West Lake Landfill site.

The portion of Area 2 to be covered by the soil cap includes that portion of the landfill identified in the RMC survey as having surface exposure rates greater than 20 μR/hr at 1 m (3.3 ft) above ground level, along with those areas in which auger holes revealed radium-bearing soil within 1 m of the surface. The shallow contaminants may be sufficiently shielded to produce low surface exposure rates; however, these shallow deposits will still produce radon emanations greater than the desired level of 20 pCi/m^2s. Therefore, the soil cover must be extended over these areas of shallow contamination.

The cover soil used should be capable of compaction to a permeability of less than 10^{-7} cm/s in order to keep radon release and soil leaching as low as possible. This value is based on common practices used for sealing of hazardous waste landfills. Because accurately measuring permeability of this magnitude is difficult, the value of 10^{-7} cm/s should be used only as a target criterion which should, if possible, be bettered. If laboratory testing of the cover soil presently used at the West Lake Landfill indicates that this permeability can be achieved, this soil would be acceptable for use as the soil cap. Otherwise, clay soil would have to be imported from off the site to be used in constructing the soil cap.

The overall estimated cost for the required work under Option B is approximately $360,000 (Table 5.1) and would require about 2 months to complete. Costs of this option may be higher if the total quantity of contaminated material to be moved is higher than the estimated quantity.

5.3 Option C: Extending the Landfill Off Site

Soil eroding on the northwest berm of Area 2 is carrying contaminated soil off the landfill property onto an adjacent cultivated field. A contributing factor to the erosion is the steepness of the berm. It would, therefore, be desirable to lessen the slope's steepness by extending the berm onto the adjacent field. This option would require the acquisition of approximately 2 ha (5 acres) of land not owned by the landfill company.

In this option, Area 1 would be treated the same as in Option B. The contaminated portion of the northwestern berm of Area 2 would not be disturbed. Instead the existing berm would be extended 13 to 16 m (42 to 52 ft) onto the adjacent field. This would require an additional solid volume of approximately 20,200 m^3 (26,400 yd^3) to give a final slope of 3:1 with 1.5 m (5 ft) of soil on top of the berm. As in Option B, this cover should receive an additional 0.3 m (1 ft) of topsoil and be seeded with native grasses to prevent erosion.

This option will require the relocation of three transmission poles. All other necessary work for Option C is as described for Option B.

The overall estimated cost for required work under Option C is approximately $470,000 (Table 5.2) and would require about 2 months to complete. The extent of work required under this option is well defined.

5.4 Option D: Removing Radioactive Soil and Relocating It

only permanent solution *

This option would involve excavating and removing all contaminated soil and debris from the West Lake Landfill and relocating it to an authorized disposal facility.

Vegetation over Areas 1 and 2 would be cleared and placed in the demolition portion of the West Lake Landfill.

All equipment stored on the two contaminated areas would be removed to another portion of the site. Gravel piles in Area 2 should be removed. The lower 10 to 15 cm (4 to 6 in.) of rock should be left in place to be disposed of with other contaminated materials, since this gravel may have become mixed with contaminated soil at the surface.

The areas known to contain radioactive contamination at levels above the action criteria (20 μR/hr at 1 m) would be excavated initially. Next, the excavated area would be surveyed to determine the extent of contamination remaining. Excavation would continue until unacceptable levels of contamination have been removed. Immediately after excavation, the soil would be placed in 208-liter (55 gal) approved drums (or other approved containers) for transport. Containment in the drums will prevent the spread of dust and loose soil during transport.

Some of the nonradiological hazardous material known to be present in the landfill could present a serious danger to workers should they excavate into this material. Proper precautions should, therefore, be taken as the work is being performed.

Estimated costs under Option D would be $2,500,000 (Table 5.3). Transporting the contaminated soil to another site and emplacing the material there would significantly add to the cost. This option could be completed in about

3 months, providing that a suitable disposal facility were available to receive the contaminated waste.

5.5 Option E: Excavation and Temporary Onsite Storage in a Trench

Under this option, as much radioactive soil would be excavated as in Option D and would be placed in a specially prepared trench on the West Lake site but would not be placed in drums. This trench would become a temporary repository for the radioactive soil. The trench would be surrounded by an impervious clay liner to minimize leachate production and transport into the groundwater system. The cap should give acceptable rates of surface exposure and acceptable rates of radon gas release.

As under Option D, surface vegetation, machinery, and piles of crushed rock would be removed from the surface of areas to be excavated. Design of the trench is based upon the "secure landfill concept" (Shuster and Wagner, 1980) with three primary functions: eliminate direct gamma-ray exposure at the ground surface, reduce radon emanation, and prevent leaching of radionuclides to the groundwater system.

The excavated area would be cut to a maximum elevation of 140 m (460 ft) msl over the area to be covered by the trench. The base of the trench would cover an area 120 x 120 m (394 x 394 ft) and would have a negligible slope. Low spots would be filled with borrow soil* compacted to at least 90% of its standard Proctor density (SPD). Once the base for the trench has been leveled to a final elevation of about 140 m (460 ft) msl, a blanket of borrow soil at least 1.5 m (5 ft) thick compacted to at least 90% SPD would be emplaced. Specification of compaction of this underlayer is based on the requirement of avoiding subsidence which could cause the clay liner to crack and fail. A clay liner would be placed above the underlayer. The liner would be 0.5 m (1.6 ft) thick and would have a permeability less than 10^{-8} cm/s (4×10^{-9} in./s). An impermeable plastic liner could also be used.

*Borrow soil refers to a clayey-silt loess (Soil Conservation Service type CL) excavated southeast of the site for use as daily cover in the landfilling operation.

Sides of the trench would be built at a 3:1 slope up to the level of the surrounding undisturbed landfill surface, about 143 m (470 ft) msl. The walls would consist of an underlayer and liner as described for the base. A layer of crusher-run limestone 0.5 m (1.6 ft) thick would be placed on top of the liner to allow leachate buildup in the trench to be monitored and to facilitate pumping should leachate buildup become a problem.

After the base and walls of the trench have been built, the previously excavated debris would be placed in the trench. Then the remaining radioactive debris would be excavated and placed in the trench. As excavation proceeds, it will become apparent how much volume the trench must have to contain all the contaminated soil. At this point, the walls of the trench would be raised to an appropriate level. Excavation and filling can then proceed until the work is complete. The final thickness of debris is expected to be from 4 to 6 m (13 to 20 ft).

A cover, as described below, would be placed over the debris. A 1 m (3 ft) layer of borrow soil compacted to 90% SPD will be placed over the debris. A clay liner 0.5 m (1.6 ft) thick of permeability less than 10^{-8} cm/s (4 x 10^{-9} in./s) would be placed over the borrow soil blanket. A 0.5-m (1.6-ft) layer of crusher-run limestone would be placed over the clay layer to prevent infiltration water from building up over the liner. A cover soil layer of average thickness about 2 m (7 ft) would be placed over the rock layer.

The cover soil would be compacted and built with a surface slope of from 2% to 4% to minimize erosion. Three-tenths of a meter (1 ft) of top soil would be placed over the cover layer and would be seeded and mulched to establish a vegetative cover.

Once the trench has been prepared to accept the soil, workers may begin to excavate contaminated soil. As under Option C, an initial excavation would remove the area of known contamination, and a cleanup phase would remove all soil containing radionuclide concentrations above an action level of 15 pCi/g Ra-226. As soon as the soil has been excavated, it would be hauled to the trench and emplaced. The contaminated soil should be sufficiently compacted to prevent settling, to maintain the integrity of the soil cap. As fill is being emplaced, the pipe for a monitoring well would be extended upward from the base of the gravel underdrain. This well should be designed in a manner that would allow future installation of a pump for drawing off leachate should this become necessary.

Costs for Option E would be approximately $2,150,000 (Table 5.4). The estimated costs vary somewhat, since the exact limits of excavation cannot be defined until work begins. This work would require approximately 4 months to complete.

5.6 Option F: Construction of a Slurry Wall to Prevent Offsite Leachate Migration

Under Option F, radioactive soil would be left in place at the West Lake site. The wastes would be stabilized by means of a soil cover (as under Option B) and a downgradient slurry wall would be built around the contaminated soil. The slurry wall would be intended to keep leachate from migrating off site. This remedial action would be somewhat more effective than Option B in reducing the potential for groundwater contamination. However, costs incurred would be substantially higher than those for Option B or C. Benefits would be nearly identical to those derived by the soil cover and berm stabilization alone; the sole advantage of Option F over Option B or C would be greater protection to groundwater in the Missouri River alluvium. *

Vegetation, machinery, and piles of crushed rock would have to be removed as described for Option B. A slurry wall would be constructed by excavating a trench [approximately 1 m (3.3 ft) wide] to the depth of bedrock. This trench would be bored out in the presence of a mud weighted with bentonite (clay) to keep the walls from collapsing and to keep groundwater from intruding into the trench. The trench would be excavated in sections 6 to 8 m (20 to 26 ft) long. Once a section of trench has been excavated, concrete would be poured by tremie into the trench to displace the slurry. The final slurry walls would each consist of a concrete slab about 1 m (3.3 ft) thick extending to bedrock and partially encircling the bodies of radioactive soil in both Areas 1 and 2. A total of approximately 1300 linear meters (4,300 ft) of wall would be constructed to depths varying from 5 to 15 m (16 to 50 ft).

After each of the slurry walls had been emplaced, fill would be added along the face of the berm to stabilize the slope. Finally, a soil cover would be placed over the contaminated areas. The berm would be stabilized and the soil cover would be placed as outlined for Option B.

Costs of work required for Option F would be approximately $5,600,000 (Table 5.5). The exact amount of slurry wall cannot be determined until work is begun; therefore, this cost will be highly variable. Since the walls should extend to bedrock, the depth of soil and landfill debris will govern the depth of the required wall. Slight errors in estimating the depth of alluvium could result in large errors in the cost estimate. It is estimated that it would take 6 to 8 months to complete this option. *

Table 5.1 Itemized cost of remedial action, Option B

Item	Quantity	Unit price	Cost	Reference
Clearing and grubbing	2.9 ha	\$1850/ha	\$ 5,365	*
Remove Shuman Building	--	--	\$ 6,200	**
Excavate contaminated soil and redeposit it at a secure site	7500 m^3	\$10/m^3	\$ 75,000	†
Emplace soil cover	48,000 m^3	\$4.64/m^3	\$222,720	†
Bury clean rubble	225 m^3	\$12.50/m^3	\$ 2,812	†
Seed and mulch cover	3.3 ha	\$2165/ha	\$ 7,145	*
Subtotal			\$319,242	
Contingency @ 10%			31,924	
Engineering and legal fees @ 5%			15,962	
Estimated total cost			\$360,000††	

*Dodge Guide to Public Works and Heavy Construction, 1984.

**Ford, Bacon and Davis Utah, Inc., "Engineering Evaluation of the Latty Avenue Site, Hazelwood, Missouri," NRC Contract No. NRC-02-77-197, 1978. (This Butler-type building has already been removed.)

†Based on best estimated cost.
††Adjusted for deletion of building removal.

Table 5.2 Itemized cost of remedial action, Option C

Item	Quantity	Unit price	Cost	Reference
Clearing and grubbing	2.9 ha	$1850/ha	$ 5,365	*
Remove Shuman Building	--	--	$ 6,200	**
Relocate power transmission poles	3	$2060	$ 6,180	†
Stablize berm (fill)	20,200 m^3	$6.70/$m^3$	$135,340	†
Emplace soil cover	48,000 m^3	$4.64/$m^3$	$222,720	†
Bury clean rubble	225 m^3	$12.50/$m^3$	$ 2,812	†
Seed and mulch cover	3.3 ha	$2165/ha	$ 7,145	*
Subtotal			$385,762	
Contingency @ 10%			38,576	
Engineering and legal fees @ 5%			19,290	
Land acquisition	2 ha	$15,500/ha	31,000	
Estimated total cost			$470,000	

*Dodge Guide to Public Works and Heavy Construction, 1984.

**Ford, Bacon and Davis Utah, Inc., "Engineering Evaluation of the Latty Avenue Site, Hazelwood, Missouri," NRC Contract No. NRC-02-77-197, 1978. (This Butler-type building has already been removed.)

†Based on best estimated cost.

Table 5.3 Itemized cost of remedial action, Option D

Item	Quantity	Unit price	Cost	Reference
Clearing and grubbing	2.9 ha	\$1850/ha	\$ 5,365	*
Remove Shuman Building	--	--	\$ 6,200	**
Bury clean rubble	230 m^3	\$12.5/m^3	\$ 2,875	†
Excavate contaminated soil	70,000 m^3	\$5.25/m^3	\$ 367,500	†,††
Site decontamination	27,600 m^3	\$1.4/m^2	\$ 38,640	***
Packing waste for transportation	70,000 m^3	\$25/m^3	\$1,750,000	†
Subtotal			\$2,170,580	
Contingency @ 10%			217,058	
Engineering and legal fees @ 5%			108,529	
Estimated total cost			\$2,500,000***	

*Dodge Guide to Public Works and Heavy Construction, 1984.

**Ford, Bacon and Davis Utah, Inc., "Engineering Evaluation of the Latty Avenue Site, Hazelwood, Missouri," NRC Contract No. NRC-02-77-197, 1978. (This Butler-type building has already been removed.)

***No costs have been included here for moving the waste, for emplacing it and for disposal facility users fees.

†Based upon best estimate.

††Estimated quantity of soil having Ra-226 concentrations of 15 pCi/g or more.

Table 5.4 Itemized cost of remedial action, Option E

Item	Quantity	Unit price	Cost	Reference
Prepare secure trench	80,000 m^3	$9/$m^3$	$ 720,000	*
Clearing and grubbing	2.9 ha	$1,850/ha	$ 5,365	*
Remove Shuman building			$ 6,200	**
Bury clean rubble	230 m^3	$12.5/$m^3$	$ 2,875	*
Excavate contaminated soil	70,000 m^3	$5.25/$m^3$	$ 367,500	*
Site decontamination	27,600 m^3	$1.40/$m^3$	$ 38,640	†
Emplace contaminated soil	70,000 m^3	$10.3/$m^3$	$ 722,200	*
Monitoring well	---	---	$ 6,000	*
Seed and mulch cover	0.08 ha	$2,165/ha	$ 200	†
Subtotal			$1,868,980	
Contingency @ 10%			186,900	
Engineering and legal fees @ 5%			93,450	
Estimated total cost			$2,150,000	

* Dodge Guide to Public Works and Heavy Construction, 1984.

**Ford, Bacon and Davis Utah, Inc., "Engineering Evaluation of the Latty Avenue Site, Hazelwood, Missouri," NRC Contract No. NRC-02-77-197, 1978. (This Butler-type building has already been removed.)

† Based on best estimate.

Table 5.5 Itemized cost of remedial action, Option F

Item	Quantity	Unit price	Cost	Reference
Clearing and grubbing	2.9 ha	$1,850/ha	$ 5,365	*
Remove Shuman building			$ 6,200	**
Relocate power transmission poles	7 poles	$2,060/@	$ 14,420	†
Construct slurry wall	11,000 m^2	$402/$m^2$	$4,422,000	*
Stabilize berm	20,200 m^3	$6.70/$m^3$	$ 135,340	†
Emplace soil cap	48,000 m^3	$4.64/$m^3$	$ 222,720	†
Bury clean rubble	225 m^3	$12.5/$m^3$	$ 2,812	†
Seed and mulch cover	3.3 ha	$2,165/ha	$ 7,145	*
Subtotal			$4,816,002	
Contingency @ 10%			481,600	
Engineering and legal fees @ 5%			240,800	
Land acquisition	2 ha	$15,500/ha	31,000	
Estimated total cost			$5,600,000	

*Dodge Guide to Public Works and Heavy Construction, 1984.

**Ford, Bacon and Davis Utah, Inc., "Engineering Evaluation of the Latty Avenue Site, Hazelwood, Missouri," NRC Contract No. NRC-02-77-197, 1978. (This Butler-type building has already been removed.)

†Based on best estimate.

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THE REMOTE SENSING LABORATORY OF THE UNITED STATES DEPARTMENT OF ENERGY

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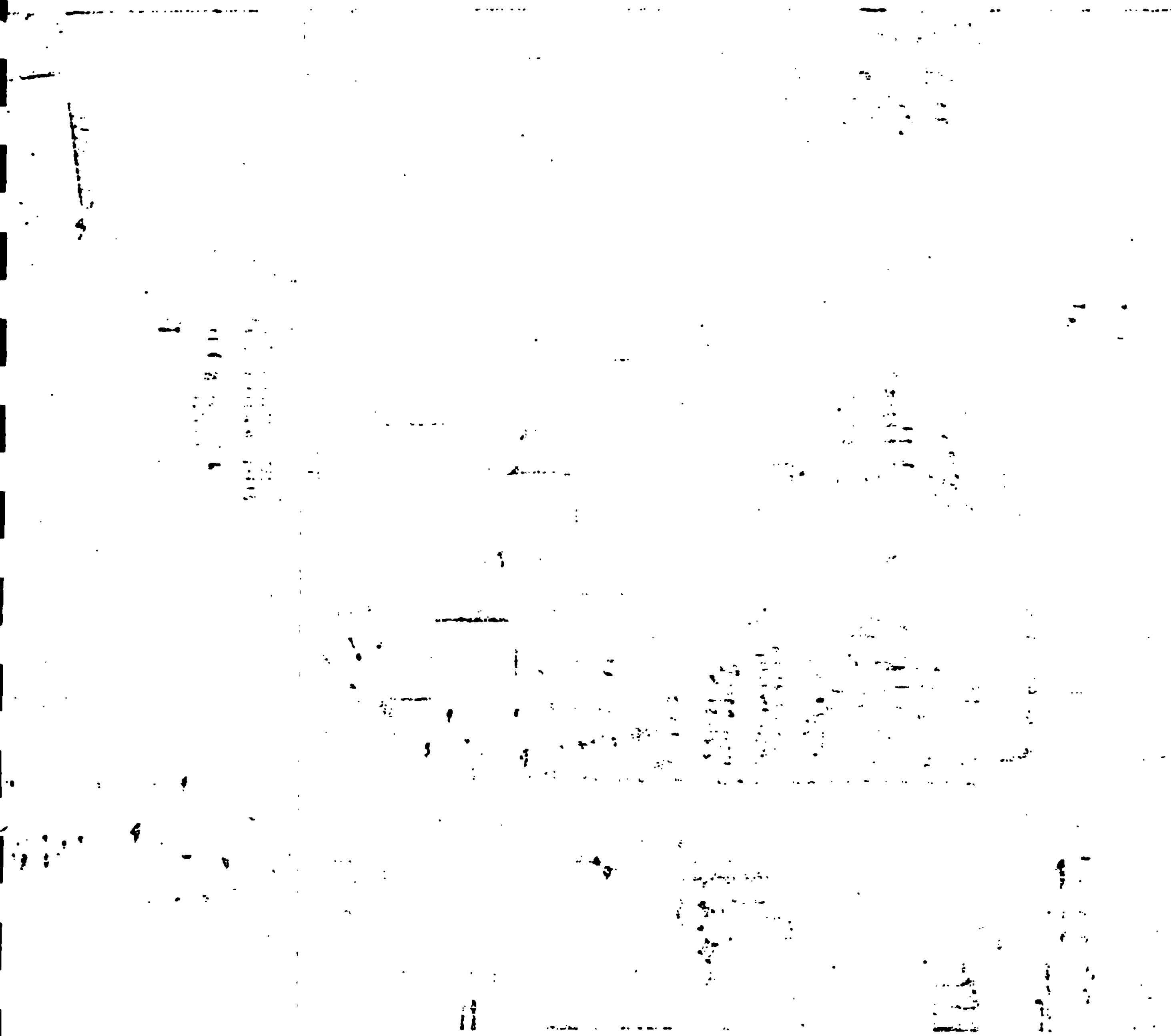
SEPTEMBER 1979



AN AERIAL RADIOLOGICAL SURVEY OF THE AREA SURROUNDING THE

MALLINCKRODT NUCLEAR MARYLAND HEIGHTS FACILITY AND TWO ADDITIONAL SITES

ST. LOUIS, MISSOURI DATE OF SURVEY: OCTOBER 1977

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Exhibit 14-F

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L. K. Hilton
Project Scientist

APPROVED FOR PUBLICATION

T. P. Stuart, Manager
Remote Sensing Sciences Department

This Document is UNCLASSIFIED

G. P. Stobie
Classification Officer

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ABSTRACT

An aerial radiological survey to measure terrestrial gamma radiation was carried out over the Mallinckrodt Nuclear Maryland Heights Facility during October 1977.

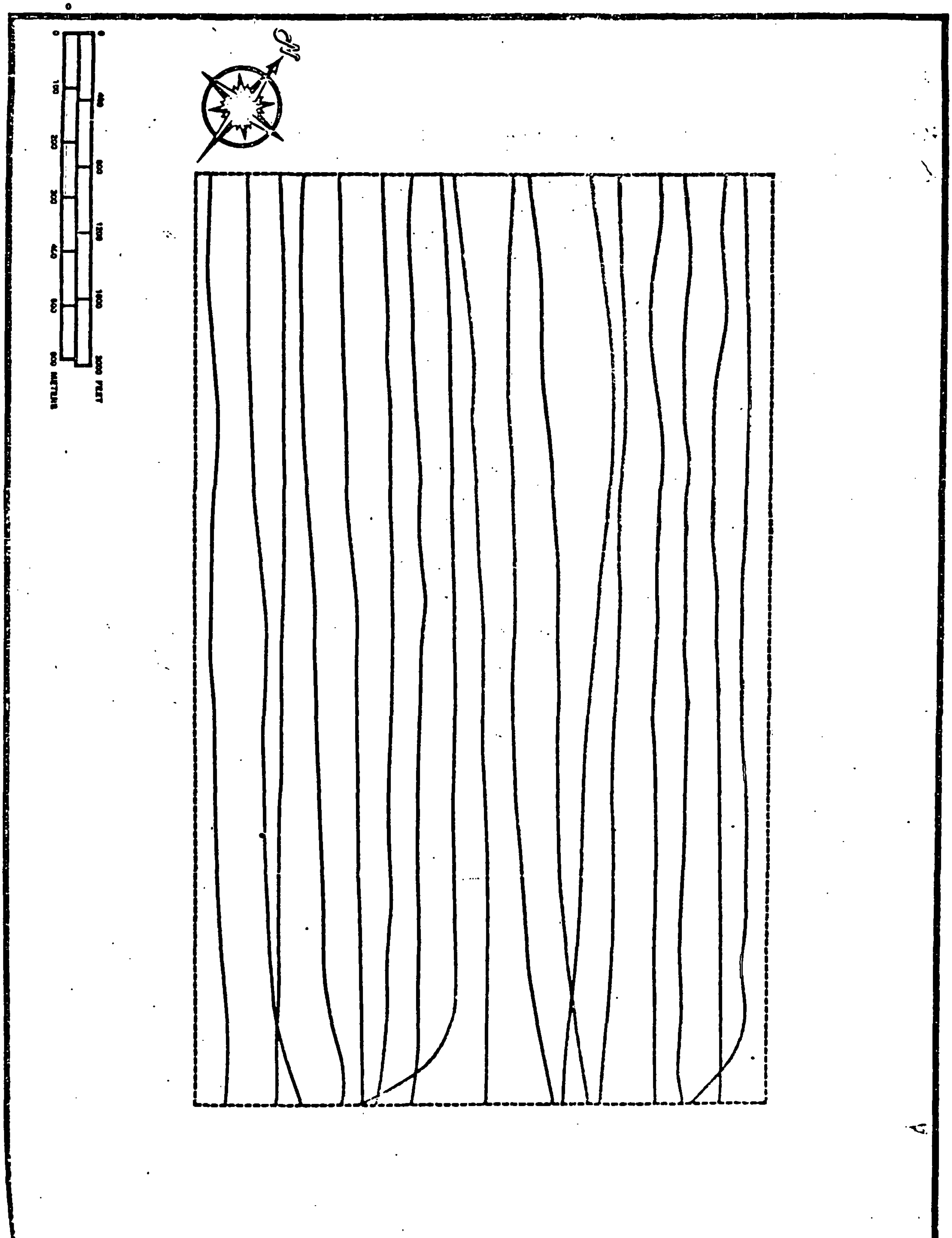
At the same time the following properties were also surveyed: a parcel near 9200 West Latty Avenue, which included a portion of St. Louis International Airport; and land used by West Lake Landfill, Inc., which is 8 km northwest of the airport.

Gamma ray data were collected by flying parallel lines 60 m apart. The total area surveyed over the three sites was 7.4 km^2.

Processed data indicated that detected radioisotopes and their associated gamma ray exposure rates were consistent with those expected from normal background emitters, except at certain locations described in this report.

Average exposure rates 1 m above the ground, as calculated from aerial data, are presented in the form of an isopleth map. No ground sample data were taken at the time of the aerial survey.

CONTENTS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1.0 INTRODUCTION

The United States Department of Energy (DOE) maintains an aerial surveillance operation called the Aerial Measuring System (AMS).* AMS is operated for DOE by EG&G. This continuing nationwide program, started in 1958, involves surveys to monitor radiation levels in and around facilities producing, utilizing, or storing radioactive materials. The purpose of the survey is to document, at a given point in time, the location of all areas containing gamma emitting radioactivity (visible at the surface), and to aid local personnel in evaluating the magnitude and spatial extent of any radioactive contaminants released into the environment. At the request of DOE, or other federal and/or state agencies (such as the United States Nuclear Regulatory Commission), AMS is deployed for various aerial survey operations.

AMS was utilized during the period 22-28 October 1977 to radiometrically survey an area 1.6 km^2 centered on the Mallinckrodt Nuclear Maryland Heights Facility. Also surveyed was an area 3.2 km^2 surrounding 9200 West Latty Avenue, which included a portion of the St. Louis International Airport. A third site surveyed was a 2.6 km^2 area centered on property operated by West Lake Landfill, Inc., 8 km northwest of the airport.

The St. Louis International Airport was the survey base of operation.

2.0 SURVEY AREA HISTORY AND LOCATION

The Mallinckrodt Nuclear Maryland Heights Facility is located at 2703 Wagoner Place, St. Louis, Missouri. This plant receives radioisotopes from various vendors and converts them to radio pharmaceutical materials. Radioisotopes which they handle include ^{131}I, ^{99m}Tc, ^{99}Mo, ^{75}Se, and ^{59}Fe. Mallinckrodt Nuclear is a Division of Mallinckrodt, Inc. (formerly, Mallinckrodt Chemical Works). Mallinckrodt, Inc. acquired the Maryland Heights facility from Nuclear Consultants, Inc. in 1965.

It is reported in an ORNL report[2] and a NRC report[3] that during the period 1942 through the late 1950's Mallinckrodt Chemical Works of St. Louis processed uranium ore. Some of the ore residues and processed wastes were stored on the airport property.

In early 1966 these ore residues and uranium-bearing processed wastes were moved from the airport property by the Continental Mining and Milling Company of Chicago, Illinois to the Latty Avenue site.

In January, 1967 the Commercial Discount Corporation of Chicago, Illinois purchased the residues; much of the material was then dried and shipped to the Cotter Corporation facilities in Canon City, Colorado. The source material remaining at the Latty Avenue site was sold to the Cotter Corporation in December, 1969. Records indicate that residues remaining on the site at that time included 74,000 tons of Belgian Congo pitchblende raffinate containing about 113 tons of uranium; 32,500 tons of Colorado raffinate containing about 48 tons of uranium; and 8,700 tons of leached barium sulfate containing about 7 tons of uranium. During the period August through November, 1970 Cotter Corporation dried some of the remaining residues and shipped them to their mill in Canon City, Colorado. By December, 1970 an estimated 10,000 tons of Colorado raffinate and 8,700 tons of leached barium sulfate remained at the Latty Avenue site.

In April, 1974 a NRC inspector was informed that the remaining Colorado raffinate had been shipped in mid-1973 to Canon City without drying and that the leached barium sulfate had been transported to a landfill area in St. Louis County. A reported 12 to 18 inches of topsoil had been stripped from the Latty Avenue site; this supposedly had been removed with the leached barium sulfate. However, analyses of soil samples taken during a NRC investigation of the Latty Avenue site in 1976 indicated the presence of uranium- and thorium-bearing residues.

The West Lake Landfill property is located off St. Charles Rock Road near Taussig Road, approximately 8 km northwest of the airport.

3.0 SURVEY METHOD AND AIRBORNE EQUIPMENT

An enlarged aerial photo of each site was used to lay out the survey flight lines (Figures 1, 2, and 3). The navigator visually directed the aircraft

*Formerly Aerial Measuring System (ARMS).

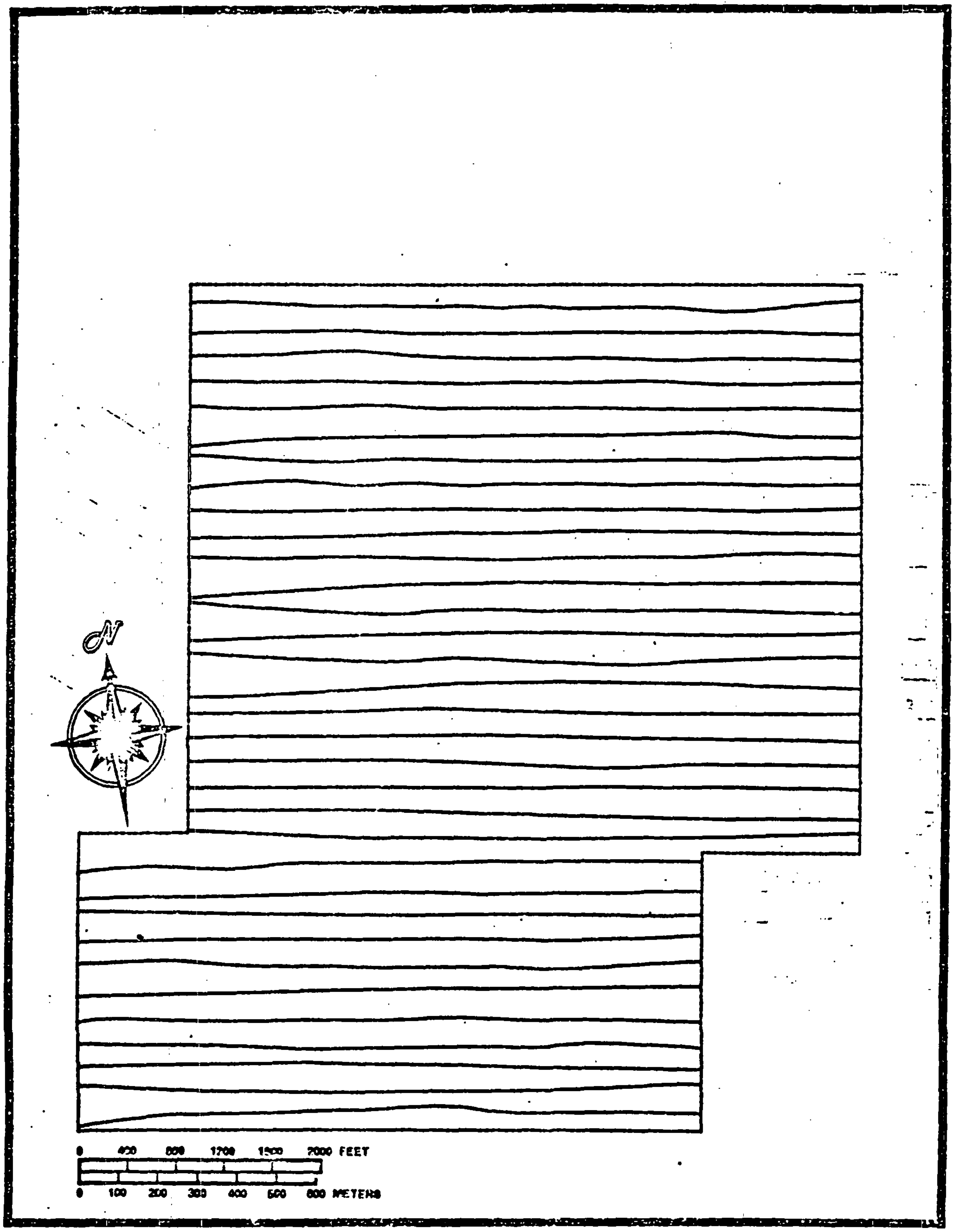


Figure 2. *FLIGHT LINES: LATTY AVENUE*

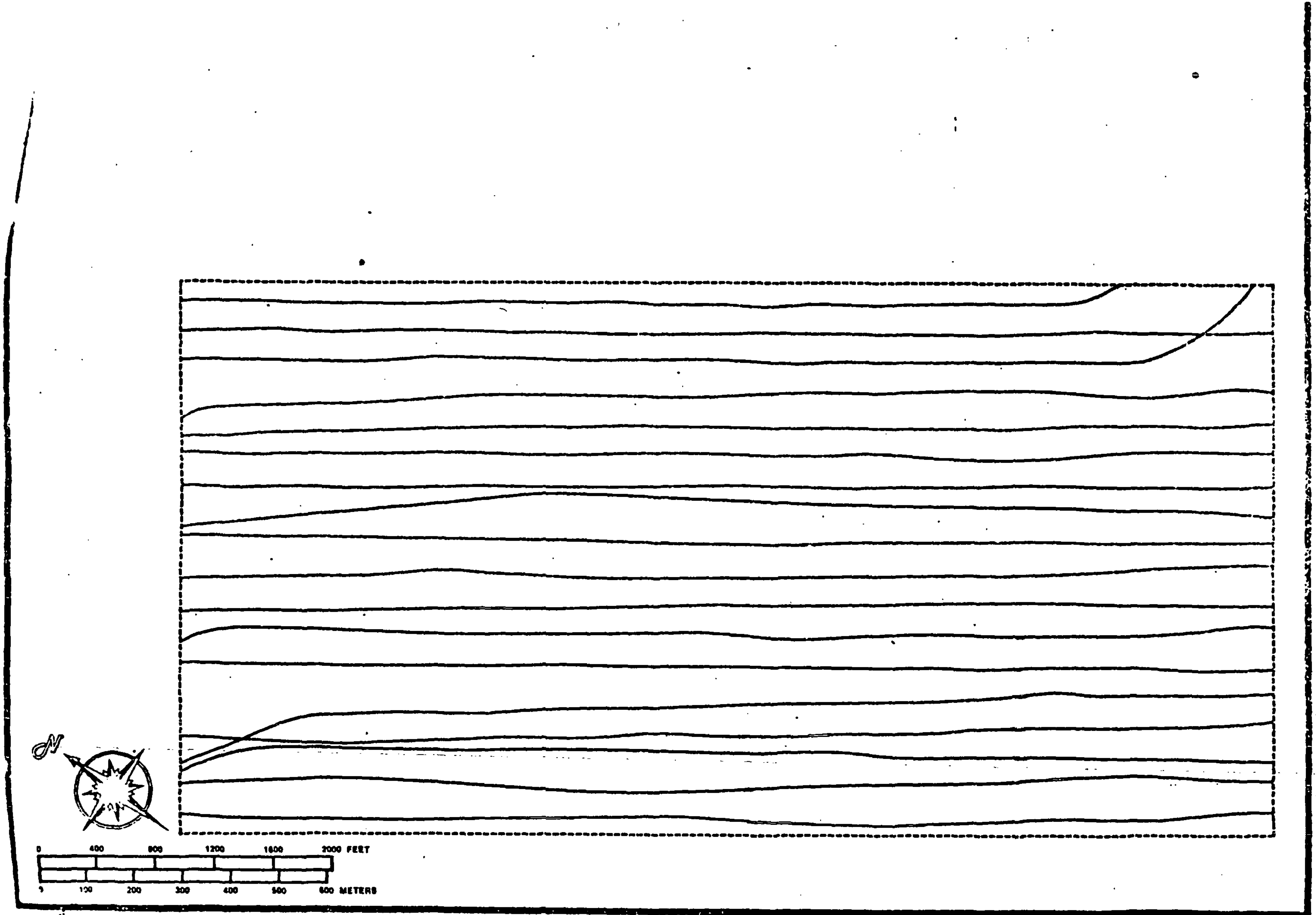


Figure 3. FLIGHT LINES: WEST LAKE LANDFILL

along the programmed flight lines on the photograph. The survey pattern consisted of parallel lines at 60 m intervals. Flight altitude was 60 m.

A Hughes H-500 helicopter was utilized for the survey (Figure 4). The H-500 carried a crew of two: pilot and navigator. The helicopter employed a lightweight version of the Radiation and Environmental Data Acquisition and Recorder system (REDAR). Two pods were mounted on the sides of the helicopter: each pod contained ten 12.7 cm diameter by 5.1 cm height NaI(Tl) detectors. Gamma ray signals from the 20 detectors were summed and routed through an analog-to-digital converter and a pulse-height analyzer. Gamma spectra were accumulated in 3-second intervals and recorded on 1/2 inch magnetic tape.

The helicopter position was established with two systems: a Trisponder/202A Microwave Ranging System (MRS), and an AL-101 radio altimeter. The trisponder master station mounted in the helicopter interrogated two remote transceivers mounted on towers outside the survey area. By measuring the round trip propagation time between the master and remote stations, the master computed the distance to each. These distances were recorded on magnetic tape each second; in subsequent computer processing these were converted to position coordinates.

The radio altimeter similarly measured the time lag for the return of a pulsed signal and converted this to aircraft altitude. For altitudes up to 150 m, the accuracy was ± 0.6 m or ± 2%, whichever is greater. These data were also recorded on magnetic tape so that any variations in gamma signal strength caused by altitude fluctuation could be accurately compensated.

The detectors and electronic systems which accumulate and record the data are described only briefly here. They are described in considerable detail in a previous report.[1]

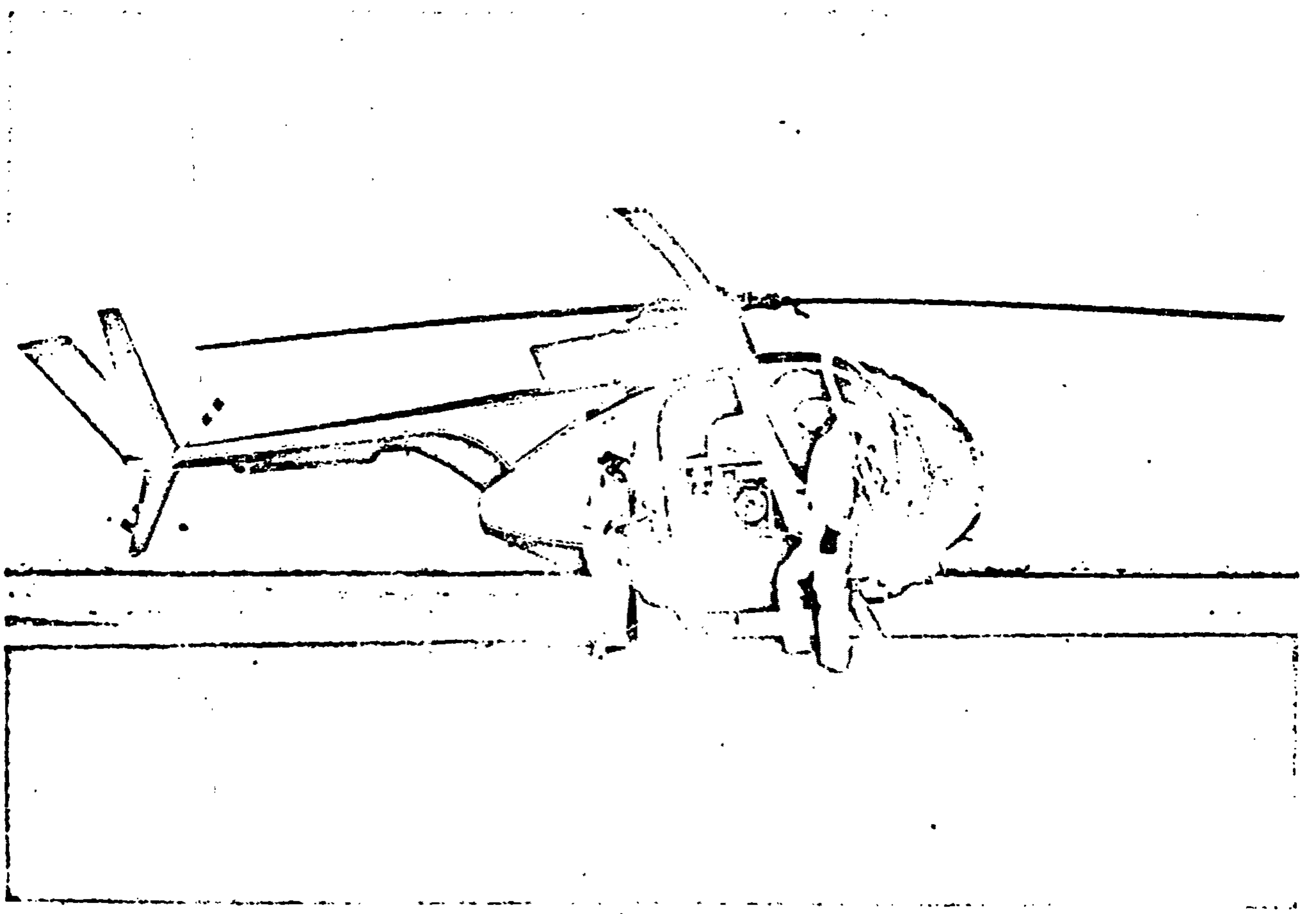


Figure 4. HUGHES H-500 HELICOPTER CONTAINING THE REDAR SYSTEM

4.0 DATA PROCESSING

Data processing was done with the Radiation and Environmental Data Analyzer and Computer system (REDAC). This is a computer analysis laboratory mounted in a mobile van (Figure 5).

REDAC consists primarily of two Cipher Data tape drives, a Data General NOVA 840 computer, two Calcomp plotters, and a Tektronics CRT display screen. The computer has a 32 k-word core memory and an additional 1.2 x 10^6-word disc memory. An extensive collection of software routines is available for data processing.

The gross count data were corrected for system dead time and altitude deviation. Corrections to the gross count rates were also made for contributions from radon, aircraft background, and cosmic rays. Flights over the Missouri River were used for this purpose.

The corrected gross count rates were converted to exposure rates at 1 m altitude, with the factor 1024 counts per second (cps) per μR/h obtained from calibration data over a Nevada test range.

5.0 DISCUSSION AND RESULTS

Analysis of the radiological data taken over the area surrounding each of the sites discussed in this report indicates that the terrestrial radioisotopes and associated gamma ray exposure rates were consistent with the natural background normally found within areas having a similar geological basis. These background exposure rates were in the 8-11 μR/h range, including 3.7 μR/h due to cosmic rays.

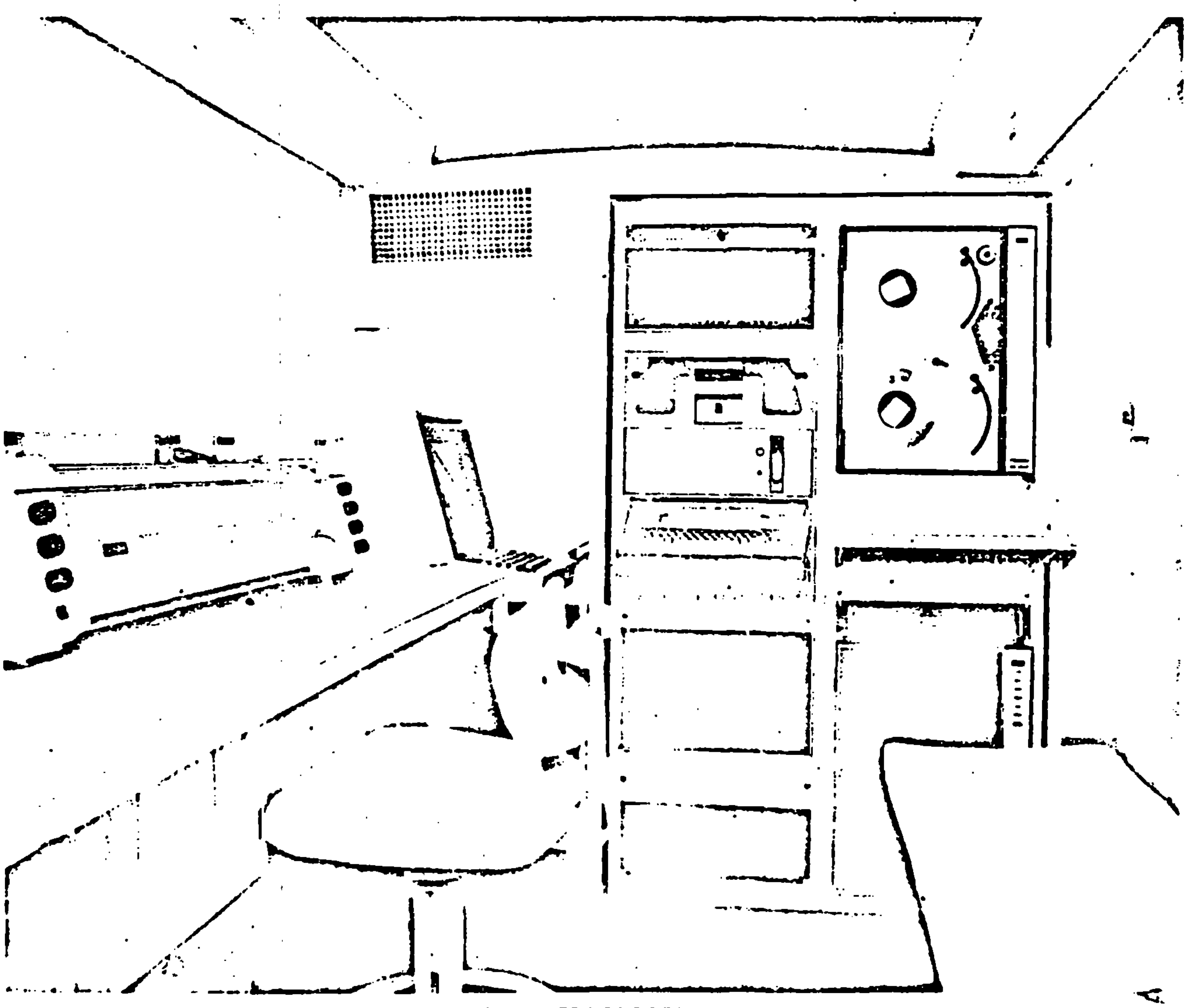
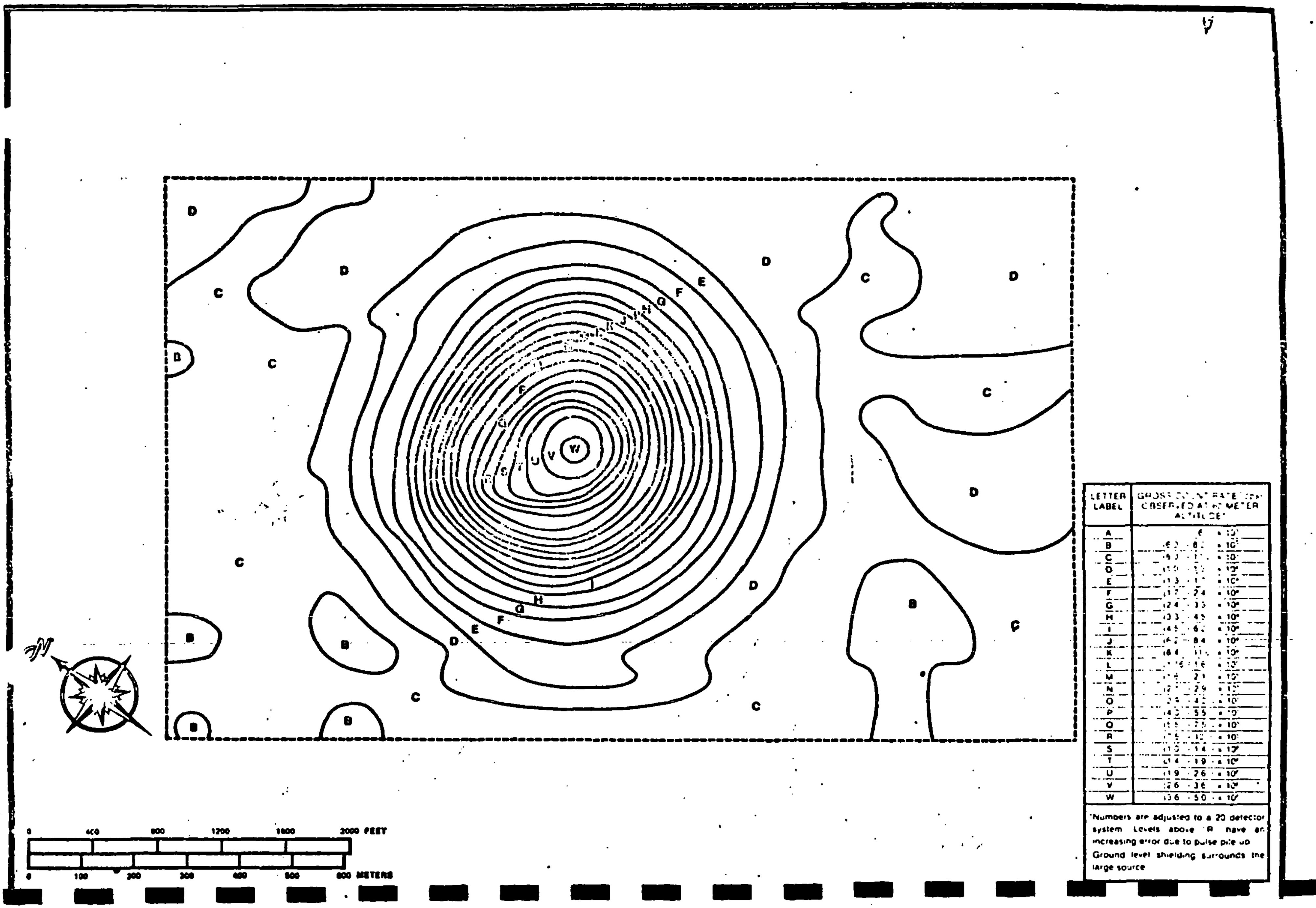


Figure 5. *MOBILE COMPUTER PROCESSING LABORATORY*



LETTER LABEL	GROSS COUNT RATE (cps) OBSERVED AT 61 METER ALTITUDE*
A	6 × 10[illegible]
B	(6.2 - 8.[illegible]) × 10[illegible]
C	(5.[illegible] - 1[illegible]) × 10[illegible]
D	(1[illegible] - [illegible]) × 10[illegible]
E	(1.3 - 1.[illegible]) × 10[illegible]
F	(1.7 - 2.4) × 10[illegible]
G	(2.4 - 3.3) × 10[illegible]
H	(3.3 - 4.5) × 10[illegible]
I	(4.5 - 6.[illegible]) × 10[illegible]
J	(6.[illegible] - 8.4) × 10[illegible]
K	(8.4 - 11.[illegible]) × 10[illegible]
L	([illegible] - 1.6) × 10[illegible]
M	([illegible] - 2.1) × 10[illegible]
N	(2.[illegible] - 2.9) × 10[illegible]
O	([illegible] - 4.[illegible]) × 10[illegible]
P	(4.[illegible] - 5.5) × 10[illegible]
Q	([illegible] - 7.5) × 10[illegible]
R	([illegible] - [illegible]) × 10[illegible]
S	(1.0 - 1.4) × 10[illegible]
T	(1.4 - 1.9) × 10[illegible]
U	(1.9 - 2.6) × 10[illegible]
V	(2.6 - 3.6) × 10[illegible]
W	(3.6 - 5.0) × 10[illegible]

*Numbers are adjusted to a 20 detector system. Levels above "R" have an increasing error due to pulse pile up. Ground level shielding surrounds the large source.

5.1 Mallinckrodt Nuclear.

Figure 6 presents gross count rate isopleths superimposed on an aerial photograph of the Mallinckrodt Nuclear Maryland Heights Facility. The isopleths shown in this figure are consistent with the existence of point sources in a storage room which has heavily shielded walls at the ground level but a lightly shielded roof. Due to this difference in shielding the aerially determined isopleths are not representative of what would be measured on the ground. For this reason, and because conversion factors apply only to uniform horizontal distributions at the ground level, the letter labels in Figure 6 have not been converted to exposure rates at the 1 m level.

Figure 7 is a background-subtracted energy spectrum of the radiation from the area of increased activity. Photopeaks observed are 364 keV and 637 keV from ^{131}I, 740 keV and 780 keV from ^{99}Mo, and 1.095 MeV and 1.292 MeV from ^{59}Fe. All three of these isotopes are received by the Facility for processing.

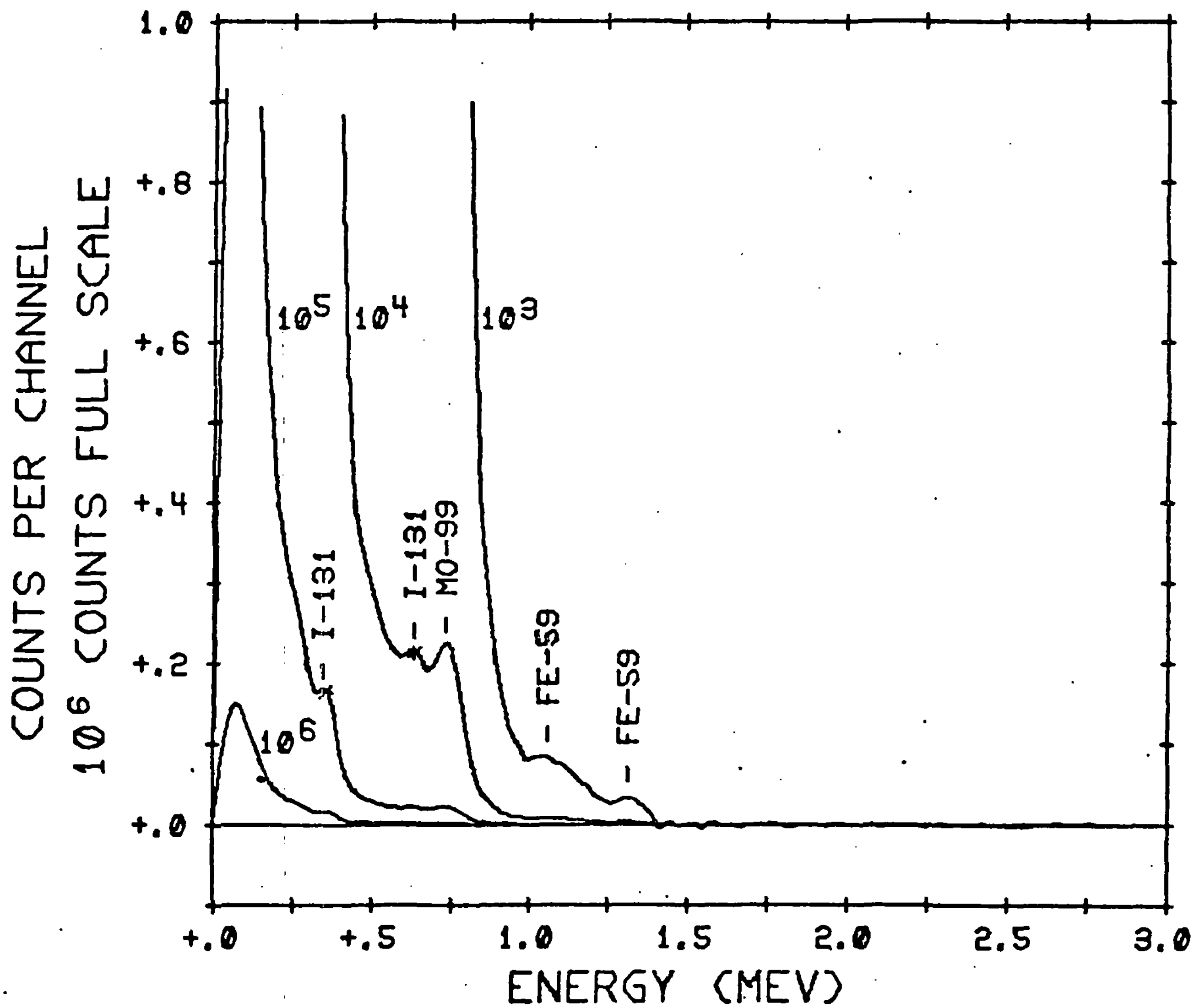
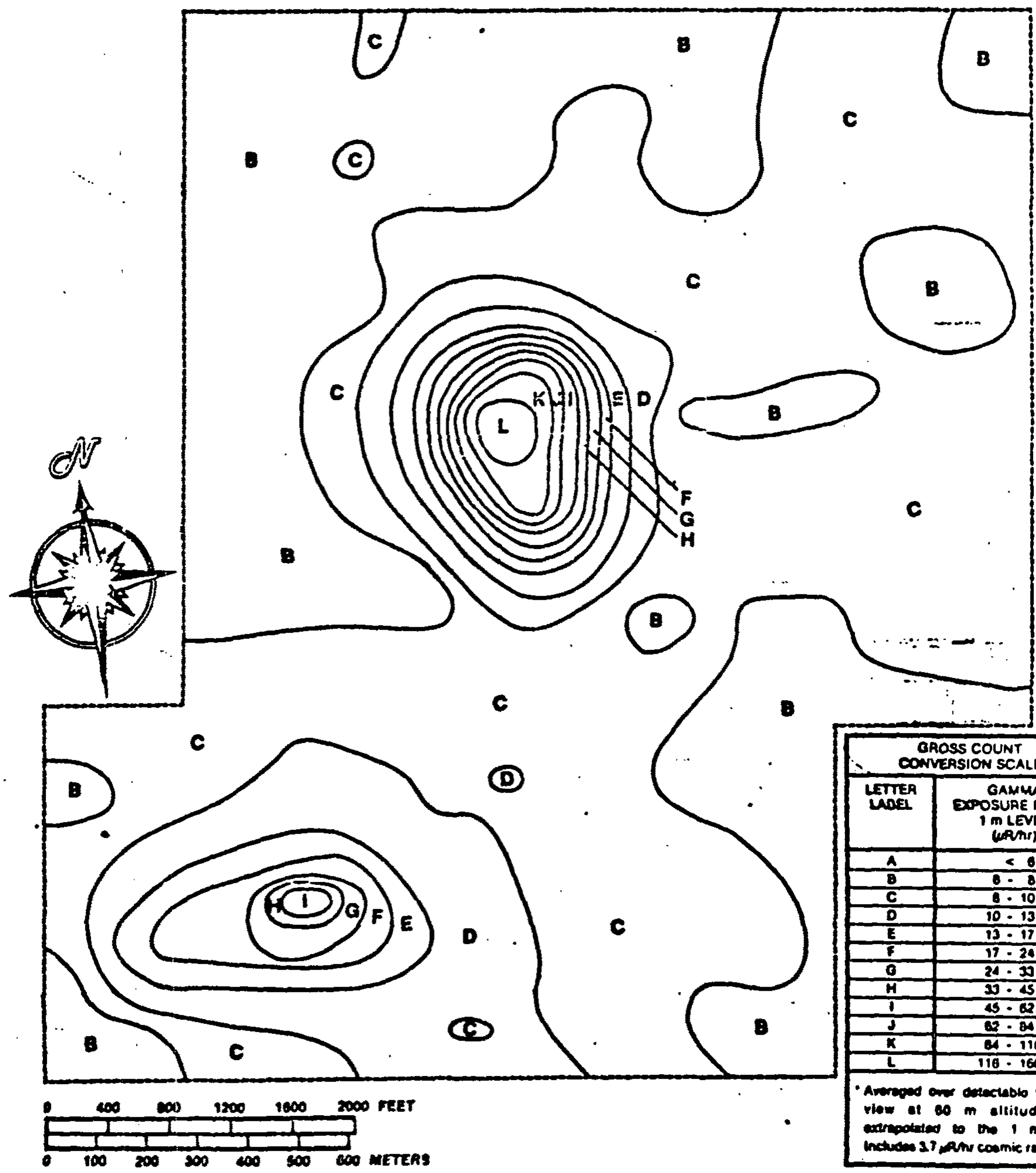


Figure 7. *BACKGROUND-SUBTRACTED ENERGY SPECTRUM: MALLINCKRODT NUCLEAR SITE*
This spectrum characterizes the enhanced activity observed in Figure 6.



GROSS COUNT CONVERSION SCALE	
LETTER LABEL	GAMMA EXPOSURE RATE* 1 m LEVEL (μR/hr)
A	< 6
B	6 - 8
C	8 - 10
D	10 - 13
E	13 - 17
F	17 - 24
G	24 - 33
H	33 - 45
I	45 - 62
J	62 - 84
K	84 - 116
L	116 - 160

* Averaged over detectable field-of-view at 60 m altitude and extrapolated to the 1 m level. Includes 3.7 μR/hr cosmic radiation.

Figure 8. *EXPOSURE RATE ISOPLETHS: LATTY AVENUE*

5.2 Latty Avenue and Airport

Figure 8 presents the exposure rate isopleths superimposed on an aerial photograph of the site. Figure 9 is a background-subtracted energy spectrum of the radiation characteristics of both areas of increased activity. Radiation from ^{214}Bi accounts for all the major photopeaks observed.

This isopleth map (Figure 8) is based on gross counts (integral counts in the energy region between .05 MeV and 3 MeV). The factor used to convert these counts to the exposure rate at the 1 m level was determined from measurements at a calibration site containing a typical mix of naturally occurring radionuclides. Since the spectrum shown in Figure 9 is different from a typical natural spectrum, the conversion factor may be in error. The isopleths, which represent ground level exposure rates for distributed sources, are consistent with sources whose lateral dimensions are a few hundred feet.

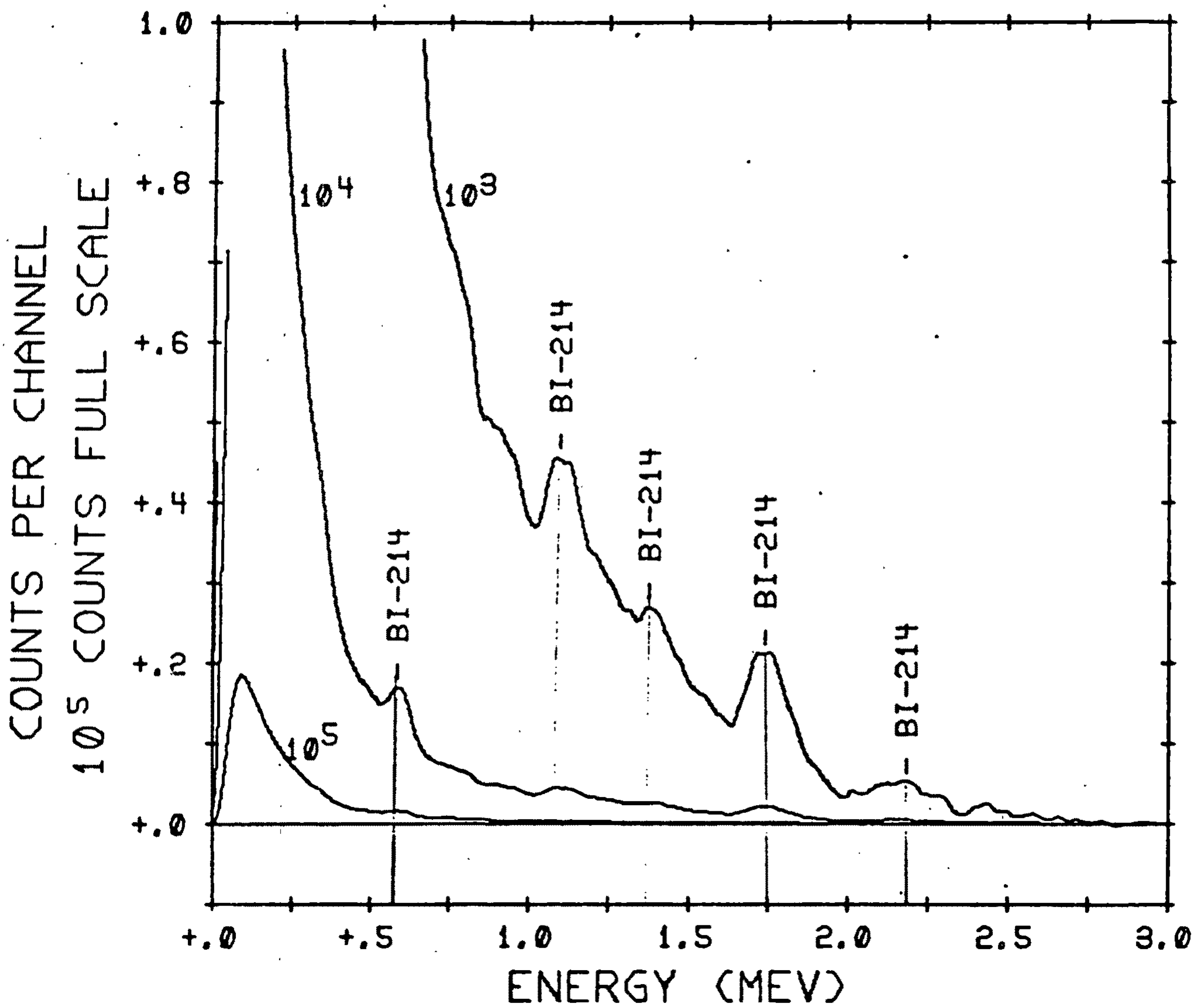
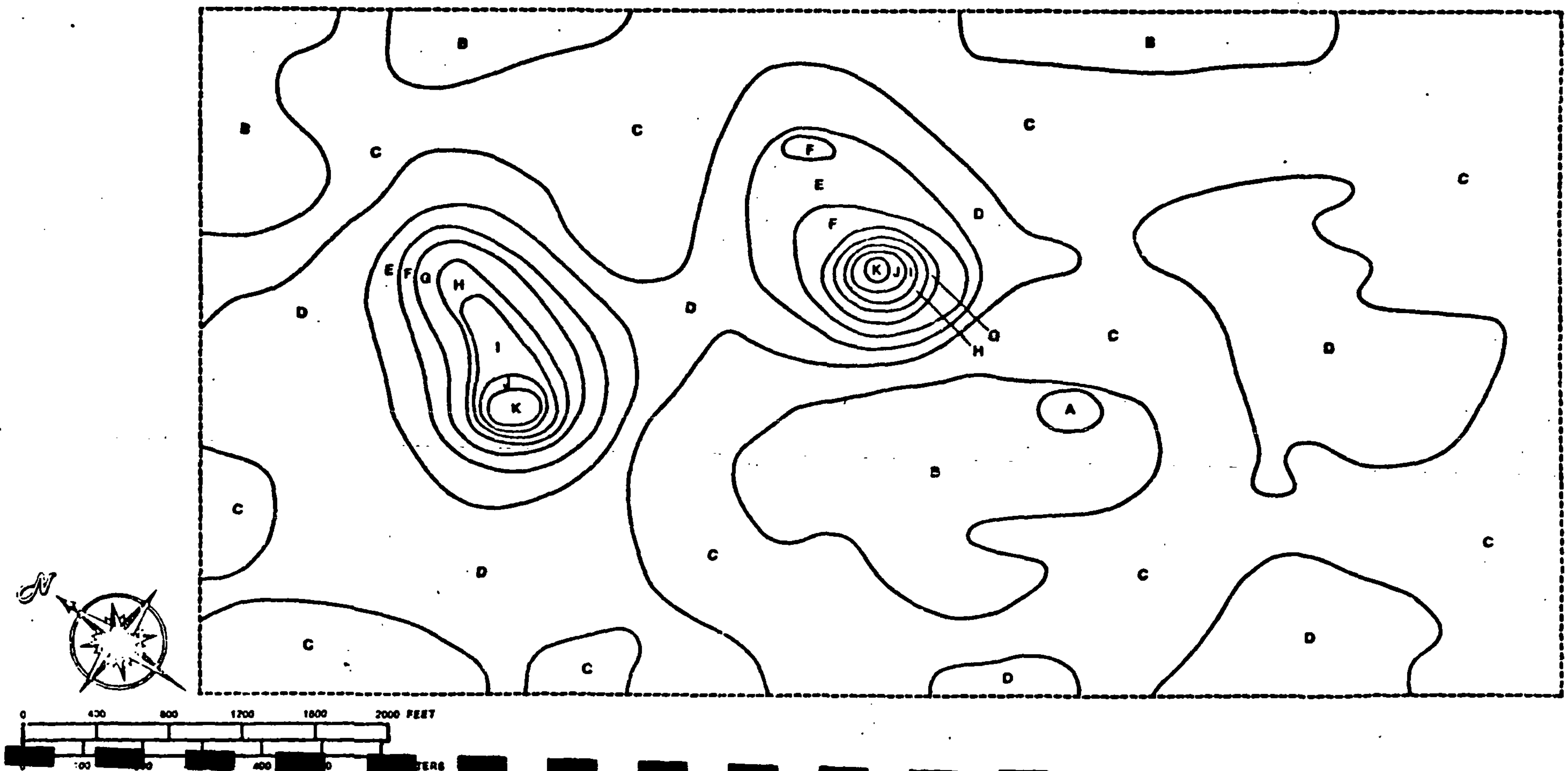


Figure 9. *BACKGROUND-SUBTRACTED ENERGY SPECTRUM: LATTY AVENUE*
This spectrum of gamma radiation was characteristic of the areas of increased activity at Latty Avenue and the airport as shown in Figure 8.

LETTER LABEL	Gamma Exposure Rate* 1 m Level µR/hr
A	[illegible]
B	6 - [illegible]
C	8 - [illegible]
D	10 - [illegible]
E	13 - [illegible]
F	17 - 24
G	24 - 33
H	33 - 45
I	45 - 62
J	62 - 84
K	84 - 118

* Averaged over detectable field-of-view at 60 m altitude and extrapolated to the 1 m level. Includes 3.7 µR/hr cosmic radiation.



5.3 West Lake Landfill

Figure 10 presents the exposure rate isopleths superimposed on an aerial photograph of the site. Figure 11 is a background-subtracted energy spectrum of the radiation characteristic of both areas of increased activity. Radiation from ^{214}Bi accounts for all the major photopeaks observed.

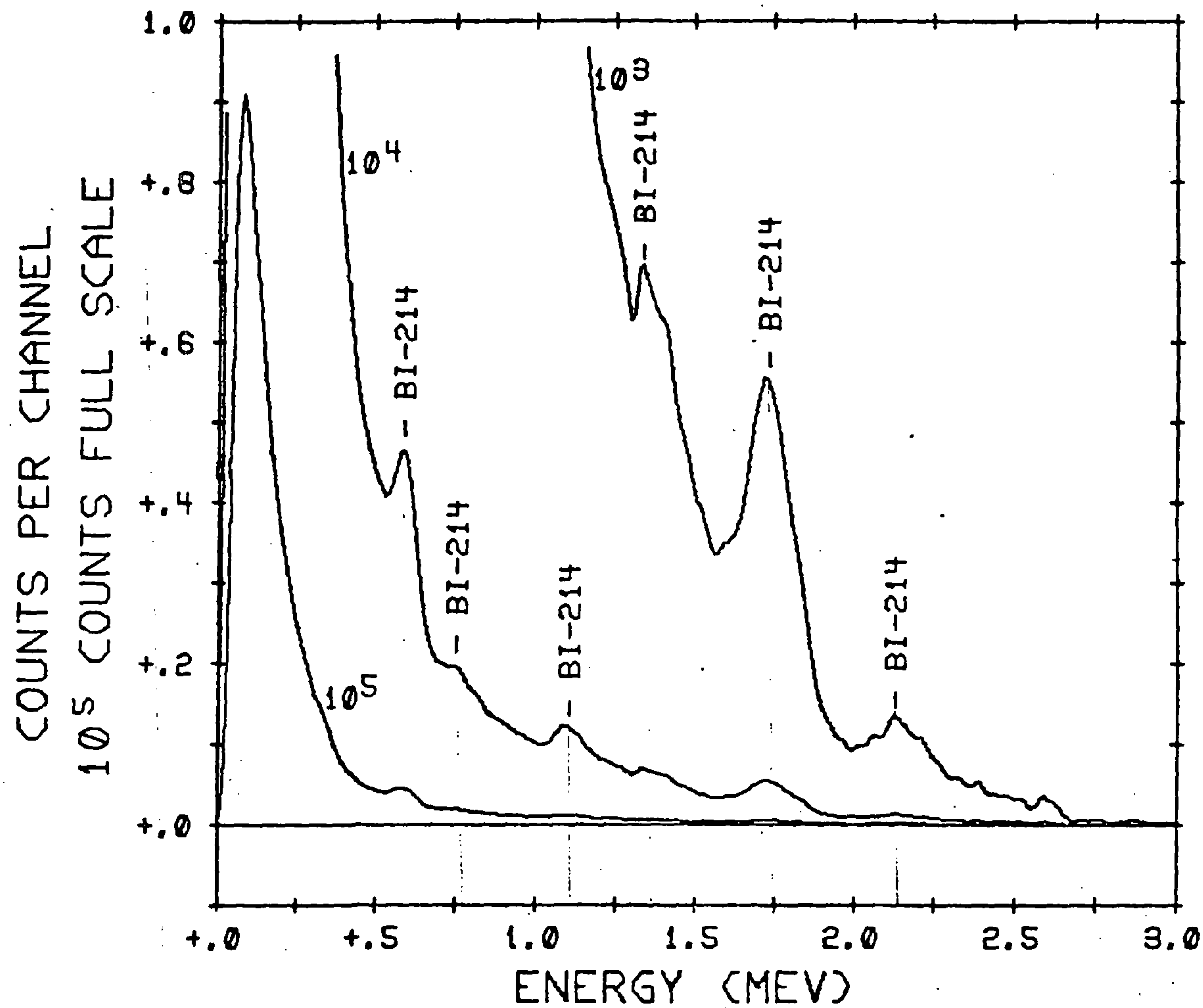


Figure 11. *BACKGROUND-SUBTRACTED ENERGY SPECTRUM: WEST LAKE LANDFILL*
Photopeaks shown here characterize both areas of enhanced activity in Figure 10.

REFERENCES

1. Boyns, P. K. July 1976. *The Aerial Radiological Measuring System (ARMS): Systems, Procedures, and Sensitivity (1976)*. Report No. EGG-1183-1691. Las Vegas, NV: EG&G.

2. Oak Ridge National Laboratory. September 1977. *Radiological Survey of the Property at 9200 Latty Avenue, Hazelwood, Missouri.* Interim Report. Oak Ridge, TN.

3. Nuclear Regulatory Comission, Office of Inspection and Enforcement. 20 October 1976. *Investigation Report No. 76-01.* Glen Ellyn, IL.

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MALLINCKRODT NUCLEAR MARYLAND HEIGHTS
FACILITY
AND TWO ADDITIONAL SITES
ST. LOUIS, MISSOURI
EGG-1183-1721
DATE OF SURVEY: OCTOBER 1977
DATE OF REPORT: SEPTEMBER 1979

EPA

POTENTIAL HAZARDOUS WASTE SITE TENTATIVE DISPOSITION

REGION: VII

SITE NUMBER: MOD079900932

File this form in the regional Hazardous Waste Log File and submit a copy to: U.S. Environmental Protection Agency; Site Tracking System; Hazardous Waste Enforcement Task Force *(EN-335)*; 401 M St., SW; Washington, DC 20460.

I. SITE IDENTIFICATION

A. SITE NAME: Westlake Landfill

B. STREET: 13570 St. Charles Rock Rd.

C. CITY: Bridgeton

D. STATE: Mo.

E. ZIP CODE: 63044

II. TENTATIVE DISPOSITION

Indicate the recommended action(s) and agency(ies) that should be involved by marking 'X' in the appropriate boxes.

RECOMMENDATION	MARK 'X'	ACTION AGENCY: EPA	STATE	LOCAL	PRIVATE
A. NO ACTION NEEDED — NO HAZARD					
B. INVESTIGATIVE ACTION(S) NEEDED *(If yes, complete Section III.)*		X			
C. REMEDIAL ACTION NEEDED *(If yes, complete Section IV.)*					
D. ENFORCEMENT ACTION NEEDED *(If yes, specify in Part E whether the case will be primarily managed by the EPA or the State and what type of enforcement action is anticipated.)*					

E. RATIONALE FOR DISPOSITION

Dioxin has not been discovered at this site in any of the sampling efforts, nor does there appear to be a problem with any of the 'standard' hazardous wastes. There is strong evidence of radioactive components above acceptable limits in the landfill. No off-site migration of these components is apparent. Strategy for this site is uncertain.

F. INDICATE THE ESTIMATED DATE OF FINAL DISPOSITION *(mo., day, & yr.)*

G. IF A CASE DEVELOPMENT PLAN IS NECESSARY, INDICATE THE ESTIMATED DATE ON WHICH THE PLAN WILL BE DEVELOPED *(mo., day, & yr.)*

H. PREPARER INFORMATION

1. NAME	2. TELEPHONE NUMBER	3. DATE *(mo., day, & yr.)*
Steven Kinser	913-236-2856	11-06-85

III. INVESTIGATIVE ACTIVITY NEEDED

A. IDENTIFY ADDITIONAL INFORMATION NEEDED TO ACHIEVE A FINAL DISPOSITION.

See Above.

B. PROPOSED INVESTIGATIVE ACTIVITY *(Detailed Information)*

1. METHOD FOR OBTAINING NEEDED ADDITIONAL INFO.	2. SCHEDULED DATE OF ACTION *(mo, day, & yr)*	3. TO BE PERFORMED BY *(EPA, Contractor, State, etc.)*	4. ESTIMATED MANHOURS	5. REMARKS
a. TYPE OF SITE INSPECTION				
(1)				
(2)				
(3)				SUPERFUND
b. TYPE OF MONITORING				NOV 7 198_
(1)				SITE LOG
(2)				
c. TYPE OF SAMPLING				
(1)	85 NOV RECD			
(2)				WQM 0014

EPA Form T2070-4 (10-79)

Continue On Reverse

Exhibit 14-G

MISSOURI DEPARTMENT OF NATURAL RESOURCE
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

NAME OF FACILITY West Lake Landfill

SAMPLES COLLECTED BY Mike Lincoln DATE(S) 10-1-80

NOTE:

SAMPLE DESCRIPTION	Well #41	Well #40	Hahn Farmhouse Well
DATE COLLECTED	10-1-80	10-1-80	10-1-80
SAMPLE NUMBER	80-7418	80-7419	80-7420
pH Units	6.3	6.7	6.7
Specific Cond. (umhos/cm @ 25° C)	4000	1450	1000
Milligrams per liter			
BOD	< 12	< 12	54
COD	19.6	25.8	90.9
NH_3 as N	0.31	0.09	0.15
NO_3+NO_2 as N	3.00	< 0.05	0.47
Total P	0.07	0.03	0.03
Total Sulfide	< 0.1	< 0.1	< 0.1
TOC	63.1	37.6	67.3
Total Cyanide	< 0.01	< 0.01	< 0.01
Non-Filterable Residue (SS)	126	162	300
Filterable Residue (TDS)	2744	839	496
Alkalinity as $CaCO_3$	690	500	360
Fluoride	0.17	0.19	0.61
Chloride 250 *	250	7.07	1.0
Sulfate	1100	177	44
Hardness as $CaCO_3$ (Ca, Mg, Fe, Zn, Mn)	1450	591	399
Potassium, Dissolved	12.3	7.6	6.9
Sodium, Dissolved	268	33.8	6.1
Calcium, Dissolved	429	166	122
Magnesium, Dissolved	93	43	23
Micrograms per liter			
Cadmium, Dissolved 10	7.2	0.6	0.1
Chromium, Dissolved	< 5	< 5	< 5
Copper, Dissolved	5	5	< 1
Iron, Dissolved, mg/l 13 *	2.08	2.82	3.13
Lead, Dissolved 50	4	3	2
Manganese, Dissolved 50 *	670	1310	770
Mercury, Dissolved	QNS*	QNS*	QNS*
Nickel, Dissolved	110	< 20	< 20
Zinc, Dissolved, mg/l	9.72	3.50	0.05
Arsenic, Dissolved	< 5	< 5	< 5
Silver, Dissolved	0.4	0.2	0.4

*Quantity not sufficient

Exhibit 14-H WQM 0015

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

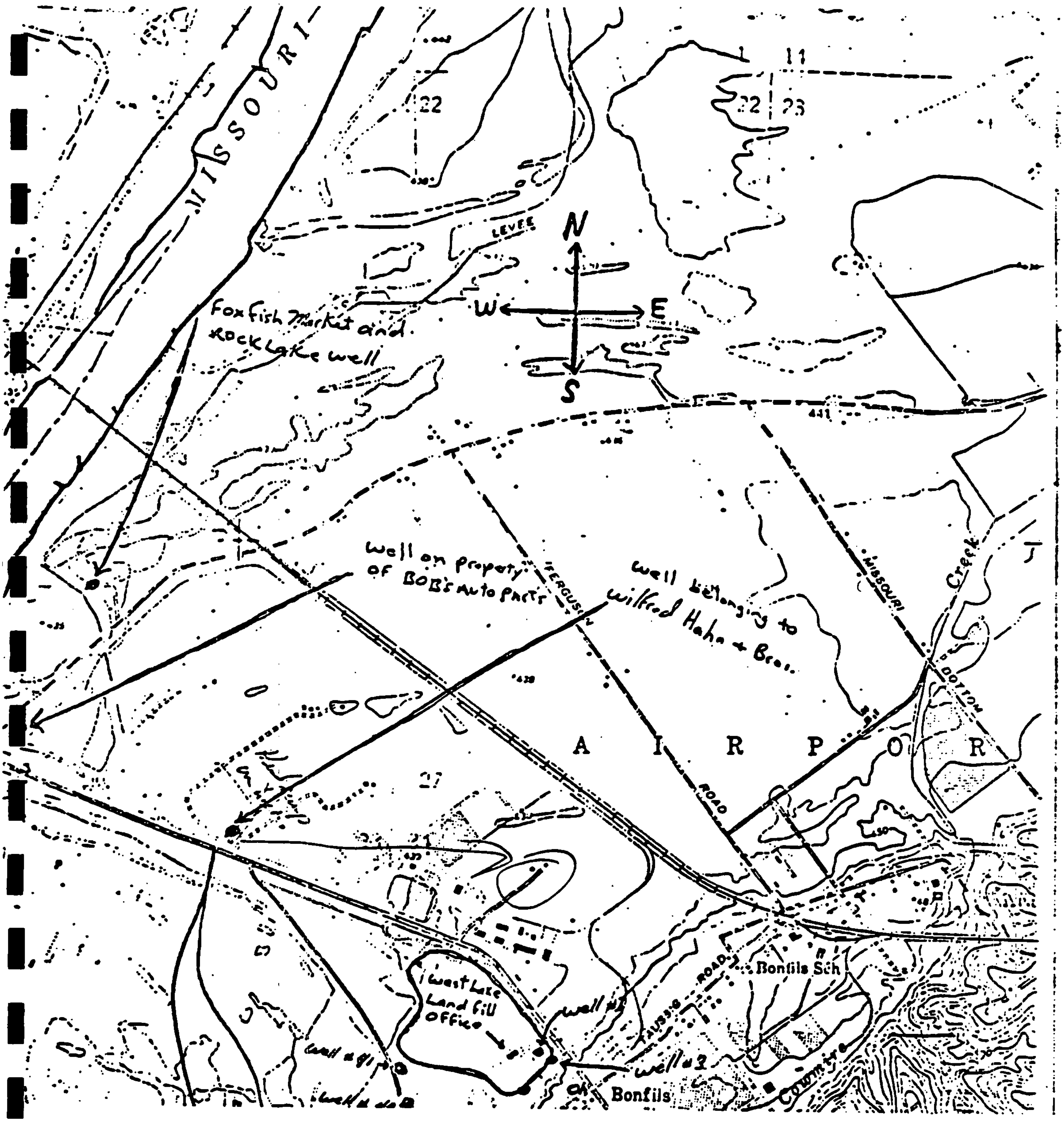
NAME OF FACILITY West Lake Landfill

SAMPLES COLLECTED BY Mike Lincoln DATE(S) 10-1-80

NOTE:

SAMPLE DESCRIPTION	Fox Fish Market Well	Shallow Well @ Bob's Auto Parts
DATE COLLECTED	10-1-80	10-1-80
SAMPLE NUMBER	80-7421	80-7422
pH Units	6.6	6.6
Specific Cond. (umhos/cm @ 25° C)	950	1900
Milligrams per liter		
BOD	< 12	< 12
COD	4.3	12.1
NH_3 as N	0.37	0.23
NO_3+NO_2 as N	< 0.05	< 0.05
Total P	0.21	0.43
Total Sulfide	< 0.1	< 0.1
TOC	18.0	35.7
Total Cyanide	< 0.01	< 0.01
Non-Filterable Residue (SS)	11	38
Filterable Residue (TDS)	492	918
Alkalinity as $CaCO_3$	396	580
Fluoride	0.42	0.22
Chloride	7.0	112
Sulfate	63	84
Hardness as $CaCO_3$ (Ca, Mg, Fe, Zn, Mn)	394	623
Potassium, Dissolved	3.8	10.3
Sodium, Dissolved	18.4	54.5
Calcium, Dissolved	110	187
Magnesium, Dissolved	29	38
Micrograms per liter		
Cadmium, Dissolved	0.2	0.7
Chromium, Dissolved	< 5	< 5
Copper, Dissolved	4	3
Iron, Dissolved, mg/l	4.18	18.6
Lead, Dissolved	2	7
Manganese, Dissolved	290	790
Mercury, Dissolved	QNS*	QNS*
Nickel, Dissolved	< 20	< 20
Zinc, Dissolved, mg/l	0.02	1.39
Arsenic, Dissolved	< 5	< 5
Silver, Dissolved	0.2	0.3

*Quantity not sufficient



MISSOURI
11
22
22
23
LEVEE
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W
E
S
Fox fish Market and Rock Lake well
Well on property of BOB's Auto Parts
Well belonging to Wilfred Hahn + Bros.
FERGUSON ROAD
MISSOURI BOTTOM
Creek
A I R P O R
27
West Lake Land Fill Office
well #1
Bonfils Sch
Bonfils

Rec'd 11/21/80

Report of Radionuclide Analysis of
Water Sample
Public Water Supply
U.S. Environmental Protection Agency

(To be filled out by public water supply) Date Received - 11/21/80

Westlake Quarry ~~PWS ID NO.~~ 80-7127 Date Sampled 10 / 30 / 80 - 10:00 A.M. (Mo.) (Day) (Year)
PWS Name Dept. Natural Resource
Address PO Box 1368
City Jefferson City State Mo Zip Code 65102

(To be filled out by laboratory)

Lab Running Sample Dept. of Community Health & Medical Care Environ. Health Laboratories
Address and City 801 S. Brentwood Blvd., Clayton, Mo. 63105
Lab ID No. 00260 Analyst Staff

Contaminant Name	Analysis Result	Analysis Date (Mo. Day Yr)	Analysis Method
Gross Alpha Particle Activity (5pc./l	8.2 ± 3.1 pCi/L	12 / 4 / 80	Std Meth.
Radium - 226	0.6 ± .1 pCi/L	12 / 4 / 80	EPA-600/4-75-008
~~Radium - 228~~		/ /	
Gross Beta Particle Activity (50pc./l		/ /	
Tritium		/ /	
Strontium - 90		/ /	
Iodine - 131		/ /	
Cesium - 134		/ /	

This form must accompany the radionuclide cubitainer to the laboratory. The public water supply will be notified by the Water Supply Field Office, U.S. EPA of the results of the radionuclide examinations.

sample

Recd 11/20/80

Report of Radionuclide Analysis of Water Sample
Public Water Supply
U.S. Environmental Protection Agency

(To be filled out by public water supply)

Date Received in lab - 11/20/80

Westlake Quarry

~~PWS ID NO~~ 80-7138

Date Sampled 10 / 30 / 80 5:10 P.M (Mo.) (Day) (Year)

PWS Name Dept. Natural Resources

Address P.O. Box 1368

City Jefferson City State MO Zip Code 65102

(To be filled out by laboratory)

Lab Running Sample: Dept. of Community Health & Medical Care, Environ. Health Laboratories

Address and City: 801 S. Brentwood Blvd.

Lab ID No.: Clayton, Mo. 63105 Analyst

Contaminant Name	Analysis Result	Analysis Date (Mo. / Day / Yr)	Analysis Method
Gross Alpha Particle Activity (5pc./1	25 pCi/l	12/4/80	Std Meth
Radium - 226	0.5 pCi/l	12/4/80	EPA-600/4-75-008/2
Radium - 228		/ /	
Gross Beta Particle Activity (50pc./1		/ /	
Tritium		/ /	
Strontium - 90		/ /	
Iodine - 131		/ /	
Cesium - 134		/ /	

This form must accompany the radionuclide cubitainer to the laboratory. The public water supply will be notified by the Water Supply Field Office, U.S. EPA of the results of the radionuclide examinations.

RECEIVED
JAN 23 1981
SOLID WASTE MANAGEMENT PROGRAM

MISSOURI DEPARTMENT OF NATURAL RESOURC..
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

NAME OF FACILITY *West Lakes Landfill*

SAMPLES COLLECTED BY *Randy Crawford* DATE(S) *10-29-80*

NOTE:

SAMPLE DESCRIPTION	*Boring #1*	*Slough on N.W. edge (grab)*
DATE COLLECTED	*10-29-80*	*10-29-80*
SAMPLE NUMBER	*80-7125*	*80-7126*
pH Units	*6.6*	*7.5*
Specific Cond. (umhos/cm @ 25° C)	*500*	*745*
Milligrams per liter		
BOD	*16*	*< 4*
COD	*64.4*	*13.8*
NH_3 as N	*0.84*	*0.04*
NO_3+NO_2 as N	*0.54*	*0.08*
Total P	*0.21*	*0.07*
MBAS	*0.34*	*< 0.04*
Total Sulfide		
TOC	*25.8*	*< 1*
Total Cyanide		
Non-Filterable Residue (SS)	*No Result**	*9*
Filterable Residue (TDS)	*No Result**	*366*
Color	*< 25*	*< 25*
Alkalinity as $CaCO_3$		
Fluoride	*0.42*	*0.36*
Chloride	*6.5*	*57.8*
Sulfate	*79*	*56*
Hardness as $CaCO_3$ (Ca, Mg, Fe, Zn, Mn)	*370*	*244*
Potassium		
Sodium		
Calcium		
Magnesium		
Temperature		*9°C*
Micrograms per liter		
Barium, *Dissolved*	*600*	*200 Total*
Cadmium, *Dissolved*	*0.3*	*0.1 Total*
Chromium, *Dissolved*	*2*	*< 1 Total*
Copper, *Dissolved*	*3*	*< 1 Total*
Iron, *Dissolved*	*150*	*240 Total*
Lead, *Dissolved*	*2*	*2 Total*
Selenium, *Dissolved*	*2*	*< 5 Total*
Manganese, *Dissolved*	*1000*	*70 Total*
Mercury, *Dissolved*	*< 0.1*	*< 0.1 Total*
Nickel		
Zinc, *Dissolved*	*700*	*14 Total*
Arsenic, *Dissolved*	*1*	*< 5 Total*
Silver, *Dissolved*	*< 0.2*	*< 0.1 Total*

**No unfiltered sample*

LSP-69/5-5-80

MISSOURI DEPARTMENT OF NATURAL RESOURC...
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

NAME OF FACILITY *West Lakes Landfill*

SAMPLES COLLECTED BY *Randy Crawford* DATE(S) *10-30-80*

NOTE:

SAMPLE DESCRIPTION	Boring #2	Black Diamond Lake (grab)
DATE COLLECTED	10-30-80	10-30-80
SAMPLE NUMBER	80-7127	80-7128
pH Units	7.2	7.5
Specific Cond. (umhos/cm @ 25° C)	1100	4000
Milligrams per liter		
BOD	6	>444
COD	37.8	845
NH_3 as N	0.22	108
NO_3+NO_2 as N	0.98	< 0.05
Total P	0.37	1.0
MBAS	0.06	0.07
Total Sulfide		
TOC	33.0	302
Total Cyanide		
Non-Filterable Residue (SS)	15452	24
Filterable Residue (TDS)	684	2064
Color	< 25	1000
Alkalinity as $CaCO_3$		
Fluoride	0.25	0.54
Chloride	42.1	355
Sulfate	159	29
Hardness as $CaCO_3$ (Ca, Mg, Fe, Zn, Mn)	465	718
Potassium		
Sodium		
Calcium		
Magnesium		
Temperature	12°C	14°C
Micrograms per liter		
Barium	700 Dissolved	300 Total
Cadmium	1.0 Dissolved	0.2 Total
Chromium	2 Dissolved	12 Total
Copper	11 Dissolved	1 Total
Iron	400 Dissolved	3200 Total
Lead	3 Dissolved	< 1 Total
Selenium	5 Dissolved	< 5 Total
Manganese	600 Dissolved	500 Total
Mercury	< 0.1 Dissolved	< 0.1 Total
Nickel		
Zinc	1310 Dissolved	238 Total
Arsenic	2 Dissolved	5 Total
Silver	< 0.2 Dissolved	< 0.1 Total

LSP-69/5-5-80

MISSOURI DEPARTMENT OF NATURAL RESOURC.
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

NAME OF FACILITY *West Lake Landfill*

SAMPLES COLLECTED BY *Randy Crawford* DATE(S) *10-30-80*

NOTE:

SAMPLE DESCRIPTION	*Boring #3*	*Boring #4*	*Boring #5 (Along St. Charles Rock Road)*
DATE COLLECTED	*10-30-80*	*10-30-80*	*10-31-80*
SAMPLE NUMBER	*80-7129*	*80-7130*	*80-7131*
pH Units	7.0	6.7	6.7
Specific Cond. (umhos/cm @ 25° C)	1100	-	1200
Milligrams per liter			
BOD	7	17	9
COD	35.1	42.2	16.9
NH_3 as N	0.11	0.23	0.02
NO_3+NO_2 as N	0.22	0.06	0.36
Total P	0.16	0.06	0.10
MBAS	0.07	0.06	0.15
Total Sulfide			
TOC	No Result*	No Result*	No Result*
Total Cyanide			
Non-Filterable Residue (SS)	8496	7310	896
Filterable Residue (TDS)	392	2040	120
Color	< 25	< 25	< 25
Alkalinity as $CaCO_3$			
Fluoride	0.32	0.20	0.17
Chloride	16.4	10.2	14.3
Sulfate	78	37	141
Hardness as $CaCO_3$ (Ca, Mg, Fe, Zn, Mn)	585	747	577
Potassium			
Sodium			
Calcium			
Magnesium			
Temperature	15°C	15°C	18°C
Micrograms per liter			
Barium, *Dissolved*	500	400	200
Cadmium, *Dissolved*	0.8	1.3	0.9
Chromium, *Dissolved*	5.6	6	4
Copper, *Dissolved*	11	7	4
Iron, *Dissolved*	1200	1000	400
Lead, *Dissolved*	4	2	2
Selenium, *Dissolved*	3	< 5	< 5
Manganese, *Dissolved*	1100	4400	300
Mercury, *Dissolved*	< 0.1	< 0.1	< 0.1
Nickel			
Zinc, *Dissolved*	550	198	132
Arsenic, *Dissolved*	1	2	< 5
Silver, *Dissolved*	< 0.2	< 0.2	< 0.2

Instrument Failure

LSP-69/5-5-80

LABORATORY SERVICES PROGRAM
Report of Sample Analysis

Sample No. 83-9803

Method 624
Volatile Organics

AMPLE DESCRIPTION:

Westlake Landfill leachate discharge to Fish Pot Creek

ate Collected: 12-14-83

Collected By: Virgil Wiesner

ffiliation: SLRO

Method:

EPA Method No. 624

emarks:

Analyzed 1/5/84. Sample exceeded holding time by 8 days.

L - The recovery of a spike in the sample was not within the control limits.

A - Not Analyzed

NR - No Result - see Remarks

D - A standard was not run and a measurable (near MDL) peak was not found at the expected retention time.

I - Tentative Identification has been made through a library search. An authentic standard has not been run. The est. conc. is based on response relative to an internal standard.

CAS No.	COMPOUND NAME	RESULTS ug/1
107-02-8	Acrolein	NA
107-13-1	Acrylonitrile	NA
71-43-2	Benzene	26
74-83-9	Bromomethane	<27
75-27-4	Bromodichloromethane	<3.2
75-25-2	Bromoform	<2.8
56-23-5	Carbon Tetrachloride	<3.1
108-90-7	Chlorobenzene	<2.4
75-00-3	Chloroethane	<27
110-75-8	2-Chloroethylvinyl ether	<8.3
67-66-3	Chloroform	<2.9
74-87-3	Chloromethane	<24
124-48-1	Dibromochloromethane	<2.8
75-34-3	1,1-Dichloroethane	11
107-06-02	1,2-Dichloroethane	<2.0
75-35-4	1,1-Dichloroethene	<2.9
540-59-9	trans-1,2-Dichloroethene	5.3
78-87-5	1,2-Dichloropropane	<1.5
10061-01-5	cis-1,3-Dichloropropene	NA
10061-02-6	trans-1,3-Dichloropropene	<2.5
100-41-4	Ethylbenzene	<2.6
75-09-2	Methylene chloride	15
79-34-5	1,1,2,2-Tetrachloroethane	<2.3
127-18-4	Tetrachloroethene	<2.4
71-55-6	1,1,1-Trichloroethane	<3.2
79-00-5	1,1,2-Trichloroethane	<3.3
79-01-6	Trichloroethene	<3.0
75-69-4	Trichlorofluoromethane	NA
108-88-3	Toluene	130
75-01-4	Vinyl chloride	<24

pproved: James H. Long

James H. Long, Director
Laboratory Services Program

istribution:
ave Bedan, Waste Management Program
Bill Price, Public Drinking Water Program

LABORATORY SERVICES PROGRAM
Report of Sample Analysis

Sample No. 83-9804

Method 624
Volatile Organics

CAS No.	COMPOUND NAME	RESULT ug/l
107-02-8	Acrolein	NA
107-13-1	Acrylonitrile	NA
71-43-2	Benzene	<1.8
74-83-9	Bromomethane	<27
75-27-4	Bromodichloromethane	<3.2
75-25-2	Bromoform	<2.8
56-23-5	Carbon Tetrachloride	<3.1
108-90-7	Chlorobenzene	<2.4
75-00-3	Chloroethane	<27
110-75-8	2-Chloroethylvinyl ether	<8.3
67-66-3	Chloroform	<2.9
74-87-3	Chloromethane	<24
124-48-1	Dibromochloromethane	<2.8
75-34-3	1,1-Dichloroethane	<2.0
107-06-02	1,2-Dichloroethane	<2.0
75-35-4	1,1-Dichloroethene	<2.9
540-59-9	trans-1,2-Dichloroethene	<3.2
78-87-5	1,2-Dichloropropane	<1.5
10061-01-5	cis-1,3-Dichloropropene	NA
10061-02-6	trans-1,3-Dichloropropene	<2.5
100-41-4	Ethylbenzene	<2.6
75-09-2	Methylene chloride	<5.4
79-34-5	1,1,2,2-Tetrachloroethane	<2.3
127-18-4	Tetrachloroethene	<2.4
71-55-6	1,1,1-Trichloroethane	<3.2
79-00-5	1,1,2-Trichloroethane	<3.3
79-01-6	Trichloroethene	<3.0
75-69-4	Trichlorofluoromethane	NA
108-88-3	Toluene	<6.5
75-01-4	Vinyl chloride	<24

SAMPLE DESCRIPTION:

Fish Pot Creek below Sulphur Spring Road Bridge 1000 feet

Date Collected: 12-14-83

Collected By: Virgil Wiesner

Affiliation: SLRO

Method:

EPA Method No. 624

Remarks:

Analyzed 1/5/84. No detectable contamination was found. Sample exceeded holding time by 8 days.

CL - The recovery of a spike in the sample was not within the control limits.

NA - Not Analyzed

NR - No Result - see Remarks

ND - A standard was not run and a measurable (near MDL) peak was not found at the expected retention time.

TI - Tentative Identification has been made through a library search. An authentic standard has not been run. The est. conc. is based on response relative to an internal standard.

Approved: James H. Long

James H. Long, Director
Laboratory Services Program

Distribution:
Dave Bedan, Waste Management Program
Bill Price, Public Drinking Water Program

✓

Appendix A

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY
LABORATORY SERVICES PROGRAM

115908

REPORT OF SAMPLE ANALYSIS
LANDFILL MONITORING PROJECT

NAME OF FACILITY Westlakes Landfill

SAMPLES COLLECTED BY Steve Berendzen DATE(S) 6-16-81

NOTE:

SAMPLE DESCRIPTION	0809 Well #34	0805 Well #35	0809 Well #38	0810 Well #39
DATE COLLECTED	6-16-81	6-16-81	6-16-81	6-17-81
SAMPLE NUMBER	81-7835	81-7836	81-7833	81-7834
pH Units	7.1	7.2	6.5	6.9
Specific Cond. (umhos/cm @ 25° C)	600	730	620	660
Milligrams per liter				
COD	56	95	No result	45
NH_3 as N	0.12	1.42	0.90	0.28
$NO_3 + NO_2$ as N	0.05	< 0.05	0.09	0.05
Total Phosphorus	0.24	0.41	0.42	0.27
Filterable Residue (TDS)	613	740	602	782
Fluoride	0.1	0.5	0.2	0.2
Chloride	44	43	7.9	44
Sulfate	90	< 10	86	210
Hardness as $CaCO_3$ (Ca,Mg)	430	630	480	530
Sodium	16	19	12	20
Calcium	99	170	120	130
Magnesium	44	50	44	50
Micrograms per liter				
Arsenic	< 5	13	< 5	< 5
Barium	100	320	260	120
Boron	< 100	< 100	590	< 100
Cadmium	9	8	< 2	6
Chromium	< 20	< 20	< 20	< 20
Cobalt	< 10	< 10	< 10	< 10
Copper	< 5	< 5	< 5	8
Iron	28,000	5,500	220	16,000
Lead	< 5	< 5	< 5	< 5
Manganese	970	2000	430	670
Mercury	No result	No result	No result	Log Error
Selenium	< 5	< 5	< 5	< 5
Silver	< 1	< 1	< 1	< 1
Zinc	11,000	4,500	< 10	1,500

EXHIBIT 14-I (Interim Report on the Proposed Ground Water Sampling Program for the Primary Phase of the Hydrogeologic Investigation, West Lake Landfill, St. Louis County, Missouri, October 1985 prepared by Burns and McDonnell, Kansas City, Missouri) will be produced at such time as it is located by Respondent.

WQM 0016

Exhibit 14-I

EXHIBIT 14-J (Hydrogeologic Investigation - West Lake Landfill Preliminary Phase Report, dated January 1985 prepared by Burns and McDonnell, Kansas City, Missouri) will be produced at such time as it is located by Respondent.

WQM 0017

Exhibit 14-J

DUPLICATE

ST. LOUIS COUNTY
DEPARTMENT OF COMMUNITY HEALTH & MEDICAL CARE
DIVISION OF ENVIRONMENTAL HEALTH CARE SERVICES
AIR POLLUTION CONTROL BRANCH

June 1, 1976 — Date

4276 — Number

OPERATING PERMIT

This permit to operate the equipment/process(es) described below is granted to:

West Lake Quarry
Name

13570 St. Charles Rock Road
Location of Equipment

Such operation to be pursuant to the conditions set out in Operating Permit Application No.: 4357

Equipment/Process(es)

#1 Asphalt Batching Plant

Cyclone Collector

Model: 270 & 370

99.8% Efficiency

Stack/Vent Identification

Blaine J Rhoades
Assistant Director
Air Pollution Control Branch

(This Permit to be visibly affixed or placed in accordance with Section 612.120 St. Louis County Air Pollution Control Code.) Ten Dollar ($10.00) fee paid.

WQM 0018

Exhibit 17-A

ST. LOUIS COUNTY
DEPARTMENT OF COMMUNITY HEALTH & MEDICAL CARE
DIVISION OF ENVIRONMENTAL HEALTH CARE SERVICES
AIR POLLUTION CONTROL BRANCH

August 7, 1979 — Date

04550 — Number

OPERATING PERMIT

This permit to operate the equipment/process(es) described below is granted to:

Westlake Quarry & Material
Name

St. Charles Rock Road & Taussig Road
Location of Equipment

Such operation to be pursuant to the conditions set out in Operating Permit Application No.: 2691

Equipment/Process(es)

Dust Suppression System

Make: Johnson-March

600 tons/hour

Stack/Vent Identification

N/A

Blaine J. Rhoades
Assistant Director
Air Pollution Control Branch

(This Permit to be visibly affixed or placed in accordance with Section 612.120 St. Louis County Air Pollution Control Code.) Ten Dollar ($10.00) fee paid.

WQM 0019
Exhibit 17-B

WLLFOIA4312 - 015 - 0172747

ST. LOUIS COUNTY
DEPARTMENT OF COMMUNITY HEALTH & MEDICAL CARE
DIVISION OF ENVIRONMENTAL HEALTH CARE SERVICES
AIR POLLUTION CONTROL SECTION

August 10, 1987 — Date

005563 — Number

OPERATING PERMIT

This permit to operate the equipment/process(es) described below is granted to:

West Lake Quarry
Name

13500 St. CHarles Rock Rd.
Location of Equipment

Such operation to be pursuant to the conditions set out in Operating Permit Application No. 6887

Equipment/Process(es)

Mineral Storage Silo

Asphalt Plant #1

Baghouse-400 SCFM

Enforceable Permit Conditions

Stack/Vent Identification

Blaine J. Rhoades
Blaine J. Rhoades, Program Manager
Air Pollution Control Section

(This permit to be visibly affixed or placed in accordance with Section 612.120 St. Louis County Air Pollution Control Code.) Fee paid $

WQM 0020

Exhibit 17-C

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

AUTHORIZATION TO DISCHARGE

UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the Federal Water Pollution Control Act, Public Law 92-500, 92nd Congress, (hereinafter, the Act) as amended, and the Missouri Clean Water Law, (Chapter 644 R.S. Mo. Cum. Supp. 1986, hereinafter, the Law),

Permit No. MO-0108634 Applicant No. MO-0108634

Owner: West Lake Quarry and Material Company

Owner's Address: 12976 St. Charles Rock Road, Bridgeton, Missouri 63044

Facility Name: West Lake Quarry and Material Company

Facility Address: 13570 St. Charles Rock Road, Bridgeton, Missouri 63044

Legal Description: U.S. Survey 131, (NW 1/4, SW 1/4, SE 1/4, Sec. 31 projected), T46N, R5E, St. Louis County

Receiving Stream & Basin: (10300200-04-00) Unnamed tributary to Missouri River (Missouri River and Eastern Tributaries Basin)

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION

Outfall #001 - Limestone Quarry

Storm water runoff.
Design flow is 700 gallons per minute/occurrence.

This permit only authorizes wastewater discharges under the National Pollutant Discharge Elimination System: it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

December 30, 1988
Effective Date

Frederick A. Brunner, Ph.D.
Director, Department of Natural Resources

October 31, 1993
Expiration Date

Permit Administrator for Missouri Clean Water Commission

MO 780-0041 (5-87)

WQM 0021

Exhibit 17-D

WLLFOIA4312 - 015 - 0172749

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

PERMIT NUMBER MO-0108634

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited, and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #001						
Flow-m^3/Day	MGD	*		*	each occurrence	estimate of total
Settleable Solids	ml/l/hr	1.0			once/each occurrence	grab
Non-Filterable Residue (Total Suspended Solids)	mg/l	45		30	once/each occurrence	grab
pH - Units	SU	**		**	once/each occurrence	grab

* Monitoring requirement only.

** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0.

MONITORING REPORTS SHALL BE SUBMITTED quarterly; THE FIRST REPORT IS DUE 4-28-89

THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1 19 80, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

MO 780-0010 (4-87)

C. SPECIAL CONDITIONS

1. Within one year of the issuance date of this permit, the permittee shall submit a completed CWC 105 Form C. All required analytical results shall be submitted.

2. This permit may be modified, or alternatively, revoked and reissued, to comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2) (C), and (D), 304(b)(2) and 307(a)(2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:

   (a) Contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or

   (b) Controls any pollutant not limited in the permit.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Act then applicable.

3. Permittee shall insure that leachate and storm water runoff from the adjacent Laidlaw, Inc. Landfill shall not be discharged through Outfall #001.

EXHIBITS 19-A THROUGH 19-WWW

MINUTES OF CORPORATE DIRECTORS' MEETINGS

Produced simultaneous with, and attached separately to, the 104(e) Response of West Lake Quarry and Material Company are copies of minutes of corporate directors' meetings. Respondent hereby asserts a confidentiality claim with respect to these minutes, pursuant to §§104(e)(7)(E) and (F) of CERCLA, 42 U.S.C. §§9604(e)(7)(E) and (F), Section 3007(b) of RCRA, 42 U.S.C. §6927(b), and 40 C.F.R. 2.203(b). Following is a listing of all the minutes, together with the dates covered by each, respectively.

18-A: Minutes of Special Meeting of Directors of West Lake Quarry and Material Company, August 1, 1966

19-B: Minutes of Special Joint Meeting of The Board of Directors and Shareholders of West Lake Quarry and Material Company, June 30, 1971

19-C: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., July 1, 1972

19-D: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., December 28, 1972

19-E: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., May 1, 1974

19-F: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., March 18, 1975

19-G: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., March 16, 1976

19-H: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., March 15, 1977

19-I: Minutes of Special Meeting of Board of Directors of West Lake Quarry and Material Company, Inc., September 14, 1977

19-J: Minutes, Monthly Meeting of The Board of Directors of Westlake Quarry and Material Company, January 28, 1986

19-K: Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, March 25, 1986

19-L: Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, April 29, 1986

19-M: Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, June 24, 1986

WLQ 0022

19-N:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, July 29, 1986
19-O:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, August 26, 1986
19-P:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, September 23, 1986
19-Q:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, October 28, 1986
19-R:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, November 25, 1986
19-S:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, January 27, 1987
19-T:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, February 24, 1987
19-U:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, March 26, 1987
19-V:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, April 30, 1987
19-W:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, June 2, 1987
19-X:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, June 30, 1987
19-Y:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, August 5, 1987
19-Z:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, September 4, 1987
19-AA:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, October 2, 1987
19-BB:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, October 2, 1987
19-CC:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, November 24, 1987
19-DD:	Minutes, Monthly Meeting of the Board of Directors of Westlake Quarry and Material Company, December 30, 1987
19-EE:	Minutes, Monthly Meeting of the Board of Directors of West Lake Quarry and Material Company, January 28, 1988

19-FF: Minutes, Monthly Meeting of the Board of Directors of West Lake Quarry and Material Company, March 4, 1988

19-GG: Unanimous Consent of Directors of West Lake Quarry and Material Company in Lieu of Annual Meeting of Board of Directors, March 16, 1988

19-HH: Minutes, Monthly Meeting of the Board of Directors of West Lake Companies, April 8, 1988

19-II: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, April 28, 1988

19-JJ: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, June 2, 1988

19-KK: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, July 8, 1988

19-LL: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, August 19, 1988

19-MM: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, September 29, 1988

19-NN: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, November 4, 1988

19-OO: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, November 17, 1988

19-PP: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, December 21, 1988

19-QQ: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, February 6, 1989

19-RR: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, February 22, 1989

19-SS: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, March 22, 1989

19-TT: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, April 26, 1989

19-UU: Statement of Unanimous Written Consent of Directors of West Lake Quarry and Material Company in Lieu of Meeting of Board of Directors, May 25, 1989

19-VV: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, May 30, 1989

19-WW: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, June 23, 1989

19-XX: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, July 26, 1989

19-YY: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, September 8, 1989

19-ZZ: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, September 22, 1989

19-AAA: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, October 25, 1989

19-BBB: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, December 8, 1989

19-CCC: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, January 2, 1990

19-DDD: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, January 25, 1990

19-EEE: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, February 28, 1990

19-FFF: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, March 28, 1990

19-GGG: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, April 20, 1990

19-HHH: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, May 29, 1990

19-III: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, June 29, 1990

19-JJJ: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, August 14, 1990

19-KKK: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, September 24, 1990

19-LLL: Minutes, Special Meeting of the Board of Directors of The West Lake Companies, October 19, 1990

19-MMM: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, October 31, 1990

19-NNN: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, November 28, 1990

19-OOO: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, December 20, 1990

19-PPP: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, January 31, 1991

19-QQQ: Certified Copy of Corporate Resolution of West Lake Quarry and Material Company, February 28, 1991

19-RRR: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, March 6, 1991

19-SSS: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, March 27, 1991

19-TTT: Minutes, Special Meeting of the Board of Directors of The West Lake Companies, April 22, 1991

19-UUU: Minutes, Special Meeting of the Board of Directors of The West Lake Companies, April 23, 1991

19-VVV: Certified Copy of Corporate Resolution of West Lake Quarry and Material Company, April 30, 1991

19-WWW: Minutes, Monthly Meeting of the Board of Directors of The West Lake Companies, June 5, 1991

PHASE II INVESTIGATION FINAL REPORT

U.S. REAL ESTATE DIVISION
FORD FINANCIAL SERVICES
EARTH CITY, MISSOURI

DAMES & MOORE

D&M Job No. 19943-002-045
June 26, 1990

WLQ 0023
Exhibit 20-A

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP
11701 BORMAN DRIVE, SUITE 340, ST. LOUIS, MISSOURI 63146
(314) 993-4599 FAX NO. (314) 993-4895

June 14, 1990

Mr. John Basilico
United States Real Estate
Ford Financial Group
13517 Lake Front Drive
Earth City, MO 63045-1414

RE: Phase II Site Investigation
Earth City Property Adjacent to West Lake Landfill
Dames & Moore Job No.: 19943-002-045

Dear Mr. Basilico:

Enclosed for your information are two (2) copies of the Phase II Site Investigation final report for the above referenced property.

Should you have any questions or wish to discuss this report in any way, please do not hesitate to contact Ms. Linda Black or myself.

Very truly yours,

DAMES & MOORE
A Professional Limited Partnership

Gary F. Vajda, P.E.
Partner (Ltd.)
Managing Principal

gfv/ken
Enclosure

PHASE II INVESTIGATION REPORT

U.S. REAL ESTATE DIVISION
FORD FINANCIAL SERVICES
EARTH CITY, MISSOURI

D&M Job No. 19943-002-045
June 14, 1990

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D&M Job No. 19943-002-045
June 14, 1990

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APPENDICES

D&M Job No. 19943-002-045
June 14, 1990

1.0 INTRODUCTION

In April, 1990, Ford Financial Services Group, U.S. Real Estate authorized Dames & Moore to proceed with a Phase II Site Investigation to further document pre-transaction conditions at property adjacent to a proposed National Priorities List (NPL) site. This report presents a summary of the field techniques employed during this investigation and conclusions based upon analytical results from collected samples.

1.1 Executive Summary

The Phase II Site Investigation involved a more in-depth investigation of organic, inorganic, and radiological contamination of the Ford Property that is believed to be related to the adjacent West Lake Landfill. Upon review and evaluation of all information obtained from this investigation, several concluding remarks can be made which best summarize this effort.

First, the gamma radiation survey conducted on surface soils in areas north and west of the West Lake Landfill (i.e., areas which receive a large amount of surface runoff from the landfill) indicated that there is no significant surface radiological contamination present. Radiological contamination present within the landfill, therefore, does not appear to have contributed any significant contamination due to surface runoff to the 23 acres surveyed.

Second, in addition to the surface soil survey just described which required the use of a direct-reading meter, surface soil samples where also collected from 0-12 inches in depth from property locations adjacent to the landfill and submitted for more in depth chemical and radiological analysis. Soil samples were collected in locations where contamination was suspected from the Phase I effort and in locations where contamination might reasonably be expected. Although very low levels (parts per billion) of organic contamination were provided in the analytical report for the two soil sample composites, these values were actually below the analytical limit of detection and are, consequently, not significant. Of all the soil samples collected (a total of 20), only the samples collected from the two (2) locations where radiological contamination had been indicated from the Phase I investigation had radiological contamination (i.e., the biased samples). No further surface radiological contamination beyond these biased locations is evident based upon this information and the gamma radiation survey.

Third, sediment/soil samples were collected and analyzed from four (4) locations where chemical or radiological contamination might reasonably be expected to have migrated from the landfill via surface water. As with the soil samples, only low level organic chemical contamination was indicated which is likewise believed to be attributed to the sampling technique and not to actual soil contamination. Radiological contamination is also not evident in these samples.

Fourth, subsurface soil conditions were also surveyed radiologically down to groundwater in several locations to the north and west of the landfill. Gamma radiation and volatile organics were measured in soil borings down to groundwater using a GM-type survey meter and a photoionization detector, respectively. Neither radiological contamination nor chemical contamination of any type was evident.

Fifth, groundwater was sampled and analyzed chemically and radiologically by installing monitoring wells in the same soil borings that were mentioned previously. Low level (part per billion) concentrations of some organic chemicals were detected in several of the groundwater samples. Several of these, however, are believed to be attributable to background contamination from the laboratory, and as such, do not represent a significant environmental concern. Two semi-volatile BNAs (chrysene and Bis (2-ethylhexyl)phthalate) were, however, also detected in very low levels (1-27 ppb) in four (4) of the well samples. Other chemical contaminants tested for in the groundwater (i.e., metals, cyanide) were not present in sufficient concentration to represent a significant environmental concern. Although radiologically speaking there were conflicting results from the two laboratories used, there does not in any case appear to be significant groundwater contamination. The one parameter that was tested and found to be somewhat elevated in some of the water samples (gross alpha) is of secondary importance since the sum of the individual components that typically comprise this parameter failed to confirm the gross alpha totals.

With the exception of two (2) biased locations adjacent to the West Lake Landfill where radiological contamination is evident (B1 and B2), it is unlikely that the results provided from this investigation can be interpreted as evidence that the radioactive material resident in the West Lake Landfill has migrated to Earth City property.

1.2 Project History Summary

In December, 1989, Ford retained Dames & Moore to prepare an assessment of the radiologic conditions at their properties in Earth City, Missouri, as part of a pre-divestiture due diligence effort. The scope of the Phase I effort was primarily to respond to concerns raised by the proximity of the West Lake Landfill, located immediately to the east of the property under review (Figure 1). On October 23, 1989, the landfill was proposed for addition to the National Priorities List under CERCLA, due to improper acceptance during the early 1970's of radiologic materials primarily from the Department of Energy's Latty Avenue operations.

Upon completion of a review of available information, and a limited sampling effort, Dames & Moore concluded that the data suggests that significant off-site migration of radioactive contaminants from the landfill via groundwater has not occurred. However, it was recommended that surface contamination attributable to landfill runoff be further characterized.

This Phase II Investigation has been developed to document more extensively field conditions by means of additional soil and water sampling for an expanded set of parameters, believed to be more representative of potential landfill contents.

1.3 Scope of Work Summary

The services performed during this Phase II investigation included the following five elements:

- **Overland Gamma Survey** - Gamma radiation levels were measured at one centimeter and one (1) meter above the ground surface to ascertain whether additional areas of surface radioactive contamination exist;
- **Surface Soil Sampling** - Discrete and composite soil samples were collected in the two known "hot spots", in random areas, and in one background location;
- **Sediment Sampling** - Discrete sediment samples were collected from drainage areas likely to be influenced by runoff from the landfill;
- **Soil Borings/Downhole Gamma Logging** - Seven soil borings were advanced to 15-25 feet depths. Cuttings were screened for organic vapors and for radiation levels. Gamma radiation levels were also measured and recorded inside the borehole, advancing in six-inch increments to the water table; and
- **Groundwater Sampling** - Monitoring wells were installed at each of the borings. Samples were collected for laboratory analysis for organic, inorganic, and radiologic parameters.

2.0 OVERLAND GAMMA SURVEY

Between April 9 and 13, 1990, Dames & Moore personnel conducted an overland gamma radiation survey of 23 acres adjacent to the landfill which had not previously been surveyed. These measurements would indicate areas, if any, where radiation levels were elevated above ambient background.

2.1 Field Investigation

The overland gamma survey covered the areas shown on Figure 2. The area to the north of the landfill, and to a lesser extent, along Old St. Charles Rock Road were surveyed to assess potential migration of radiologic materials via surface routes. Areas adjacent to the recently excavated drainage ditch/lake were surveyed to assess the levels of radiation in the material dredged from the ditch, which may have intercepted potentially contaminated groundwater.

The gamma radiation survey was set up using a 10 x 10 meter survey grid to maintain reproducibility and accuracy. Each section was first marked with stakes, using the S66 48'41" E line, road coordinates, and chain-link fence which delineates the landfill, as the three primary reference lines. Section grid lines were established 90 degrees from the reference lines at 10 meter intervals. Three grids were established - the largest encompassed the area north of the landfill and covered approximately eight (8) acres. The second was established to the west of Old St. Charles Rock Road in an area of disturbed soils recently excavated from a nearby drainage ditch/lake. The third was also established west of Old St. Charles Rock Road and paralleled nearly the entire Ford/West Lake common boundary over an area of soils excavated from the nearby drainage ditch/lake.

Two calibrated Bicron microrem radiation survey meters were used for radiation level measurements at each intersection of the grid at one centimeter and one meter above the ground surface. These instruments use a tissue-equivalent plastic scintillator as the detection medium to provide accurate dose rate information relative to biologic tissue. An instrument operability check, which included a battery, background and source check was performed daily prior to use and several times during use, to assure property instrument operation while performing the survey. Both survey instruments were calibrated by the manufacturer and certificates of calibration are attached as Appendix A.

2.2 Investigation Results

Gamma radiation levels measured during the survey of the property are tabulated in Table 1. A map of the grid points is attached as Figure 3. Background radiation measurements were recorded from several areas off-site and in ambient areas located on-site. The average background dose rate for the two instruments in these areas ranged from three (3) to six (6) microrem per hour which corresponds with levels identified by ORNL in a study titled "State Background Radiation Levels 1975-1979" (report #TM-7343) which gives levels for the East St. Louis area of between four (4) and eight(8) microrem per hour. All measurements made on the property represented actual instrument readings without background data subtraction. Raw data tabulated in Table 1, represent readings obtained at each survey point one meter and one centimeter above ground surface. The primary reference point for each grid is indicated on Table 1 and the site map (Figure 3) as point 0,0. All tables give the survey point locations based on their position relative to the reference point within the data matrix.

The U.S. Environmental Protection Agency guidelines for site cleanup and management of residual uranium and thorium (40 CFR 192, Subparts B & E) require that the exposure rate measured at a distance of one meter above the ground surface be less than 20 microrems per hour above background. In the case of the present survey, results did not exceed twice the measured background rate in any of the areas surveyed.

Contaminants located within the West Lake Landfill did not appear to influence the surface gamma radiation readings over the 23 acres surveyed. Although some fluctuations were present in the data, elevated gamma radiation readings within three times the average background measurement are not considered to be of consequence unless a systematic increase is noted. Site-wide trends were not readily apparent from the collected data.

3.0 SOIL SAMPLING

Surface soil samples were collected at several locations to characterize existing soil conditions in areas of the site adjacent to the landfill where contamination is suspected, and where contamination might reasonably be expected.

3.1 Field Investigation

Two composite soil samples (COMP-1 and COMP-2) were collected from the areas indicated on Figure 4 (shown as C1 and C2). It is believed that the soils dredged from the ditch along Old St. Charles Rock Road has been spread over these areas. These soils were therefore sampled to indicate whether any contaminants may have settled out from surface waters carried in the ditch. Each samples was collected from six points in the area shown, and submitted for analysis for total petroleum hydrocarbons (TPH), semi-volatiles, pesticides, PCBs, herbicides, metals, and cyanide, as well as radiological parameters.

Six unbiased soil samples (UB1-UB6) were collected at the locations shown on Figure 4. These areas were distributed along the general perimeter of the landfill to provide information regarding existing soil conditions. Each sample was collected at 0-6 inch depths and submitted for radiological analysis.

Biased soil samples were collected at two locations (B1 and B2) as shown on figure 4, which were identified during Phase I as having elevated gamma radiation levels. Samples B1A, B1B, B2A, and B2B were collected at 0-6 inch depths. Samples B1C and B2C were collected at 6-12 inch depths. All six samples were analyzed for several radiological parameters.

Samples were collected manually using either a stainless steel trowel or a stainless steel hand auger. Sampling equipment was decontaminated with Alconox detergent wash and a distilled water rinse between each sample.

Samples requiring radiological analysis were placed in plastic bags provided by the laboratory. Organic and inorganic samples were placed in jars provided by the laboratory (Table 2). Organic and inorganic samples were placed in an iced cooler. All samples were shipped to the respective laboratories via overnight delivery accompanied by Dames & Moore chain-of-custody records (Appendix B).

3.2 Investigation Results

A summary of organic and inorganic data is presented in Table 3. For nearly all parameters, there are no indications that samples COMP1 and COMP2 vary significantly from the background sample BKG.

Exceptions of note are the results of analyses for semi-volatile compounds. No semi-volatiles are indicated in the background sample, however, two compounds were detected in COMP1 and six compounds were detected in COMP 2. The semi-volatile compounds detected in the composite samples have been attributed to the sampling technique, which involved mixing the composite inside a plastic zip-lock bag. The background sample was collected directly into sample jars without contact with a bag.

A summary of the radiological data for soil samples is presented in Tables 4A, 4B, 4C, and 4D. All values are reported in units of picocuries per gram of sample plus or minus the error associated with the analysis at a 95 percent confidence level ($\pm$ 2 sigma). All soil samples were analyzed for gross alpha and gross beta content and the specific nuclides uranium-234, 235/236, 238; thorium-230,232; potassium-40; cesium-137 and radium-226, 228. Values reported as less than (<) a specific value, are considered below the analytical instrument's lower limit of detection. Table 4A shows that the analytical results reported for unbiased samples UB1 through UB6 are indistinguishable from the background sample collected at the same depth as well as background samples analyzed for the Phase I investigation. Biased samples collected in the two areas identified as above background in the Phase I investigation, show, as expected, elevated gross alpha and gross beta.

For area 1 (Table 4B) gross alpha and gross beta for biased samples are elevated by factors of 55 and 10.6 respectively, while for Area 2 (Table 4C) levels are elevated by factors of 200 and 31, respectively. Similarly, elevated levels of uranium-234 and 238 are reported at 6.5 and 6 times background (Table 4B) and factors of 13.3 and 8.1, respectively (Table 4C). Thorium-230 values in sample B1A and B1B average over 400 times background, while B2A and B2B average over 900 times background. Thorium-232 however averaged only 3 times and

6 times background for areas 1 and 2, respectively. Ra-226 concentrations in the biased soil samples analyzed from areas 1 and 2 averaged 31 and 34 times background respectively. The above results refer only to the data reported for the 0-6" sample depth. The reported concentrations for the above mentioned nuclides in the 6-12" depth are equally elevated for the area 1 sample but are somewhat lower for the area 2 sample.

Composite soil sample results reported in Table 4D are indistinguishable from background.

4.0 SEDIMENT SAMPLING

Sediment samples were collected at four locations at the site to characterize existing conditions in areas where contamination might reasonably be expected to have migrated via surface water.

4.1 Field Investigation

Four sediment samples (S1-S4) were collected at the locations shown on Figure 5. Samples S1 and S2 were collected from the bottom of the drainage ditch which runs along Old St. Charles Rock Road. These samples were analyzed for several radiological parameters.

Sample S3 was collected from the bottom of a ponded area near St. Charles Rock Road. Sample S4 was collected from beneath the outlet of a surface water drain which originates at the base of the landfill berm, and emerges from the embankment of Old St. Charles Rock Road. Both samples were analyzed for organic and inorganic as well as radiological parameters.

Samples were collected using either a stainless steel trowel or a stainless steel hand auger. Sampling equipment was decontaminated with Alconox detergent wash and a distilled water rinse between each sample.

Radiological samples were placed in plastic bags provided by the laboratory. Organic and inorganic samples were placed in jars provided by the laboratory (Table 2). Organic and inorganic samples were placed in an iced cooler. All samples were shipped to the respective laboratories via overnight delivery accompanied by Dames & Moore chain-of-custody records (Appendix B).

4.2 Investigation Results

A summary of organic and inorganic data is presented in Table 5, as a comparison with background soil sample BKG. For nearly all parameters, there are no indications that samples S3 and S4 vary significantly from the background sample. Mercury was detected only in sample S4, at 0.18 ppm only slightly above the reported detection limits.

- Semi-volatile analytical results are similar to the soil samples, where several compounds were detected. Again, this is attributed to the sampling technique which involved mixing of the composite sample inside of a plastic zip-lock bag. The background sample was collected directly into sample jars without contact with a bag.

A summary of the radiological data is presented in Table 6. Review of this table shows that, for the radiological parameters specified, all data is indistinguishable from background except for the gross alpha value of sample S4 which is reported as 6.6 times background. Upon reanalysis of this sample by ITC, however, a much lower gross alpha value was obtained. For reasons explained in Section 7.1.3 of this report, the second analysis, which indicated a gross alpha level of 19.3 ± 8.6, is considered to be more valid.

5.0 SOIL BORINGS/DOWNHOLE GAMMA LOGGING

Soil borings were advanced at seven (7) locations at the site to observe and assess subsurface soil conditions to the depth of the groundwater table. Additionally, gamma radiation was measured inside each borehole to provide vertical profiles of radiation levels.

5.1 Field Investigation

Soil borings were advanced to the groundwater table at seven locations shown on Figure 6, using an ATV-mounted hollow-stem auger drill rig. Samples were retrieved using a 3-inch diameter continuous sampler. Downhole drilling equipment was decontaminated between borings by pressure washing with water.

Geological observations made of the retrieved soils were maintained on Soil Boring Logs presented in Appendix D. Retrieved soils were field screened for VOCs with a photo-ionization detector, and for radiation levels with a G-M type survey meter.

Gamma radiation levels were measured inside the auger stem using an Eberline ESP-2 ratemeter and shielded SPA-3 scintillation detector. The detector was advanced in six-inch increments to depths approaching groundwater. Gamma logging measurements are shown in Tables 7-101 through 7-107, with graphical presentations in Figures 7-101 through 7-107.

5.2 Investigation Results

Borings depths ranged from 15 to 25 feet depending on the depth to groundwater. Soil types varied from silty to sandy silt, typically becoming coarser with depth. Some stiff silt or clay was noted. No volatile compounds were detected at any depth in any boring. Radiation levels were consistent with background levels.

All gamma logging data was consistent with background levels.

6.0 GROUNDWATER MONITORING

Groundwater monitoring wells were installed in each of the seven (7) soil borings at the locations shown on Figure 6. Well construction details are described in Section 6.1 and diagramed in Appendix E. Ten samples were collected for laboratory analysis according to the techniques discussed in Section 6.2. Analytical results are discussed in Section 6.3.

6.1 Monitoring Well Installation

As described in Section 5.0, soil borings were advanced by hollow stem auger. Upon completion of each boring, a 10-foot length of 2-inch diameter 0.010 slotted PVC well screen was placed to the bottom of the boring. PVC riser pipe was extended above the ground surface. A sand filter-pack was placed about the well screen as the auger flights were gradually removed from the borehole, typically to 2-feet above the top of the screened interval. A 1.5 - 2 feet thick bentonite pellet seal was placed above the sand pack. In wells MW101 and MW102, a cement slurry with a bentonite additive was placed from the top of the seal to a few feet below ground surface. At all wells, a cement-aggregate mixture was placed to the ground surface to secure the steel well protector, and to form a small concrete pad to deflect surface water away from the well. The PVC riser was fitted with a PVC screw cap and a padlock was placed on the steel protector. Well construction diagrams are shown in Appendix E.

Efforts by drilling contractor Brotcke to develop MW104 on April 12 using a tank of compressed nitrogen to drive an air-lift system were not successful. On Friday, April 13, 1990, personnel returned to develop the wells using an air compressor to drive water from the well. Purging efforts were continued for 30 minutes at each of the four wells (MW101, MW102, MW103, and MW104). The three remaining wells were not accessible due to wet ground conditions, and were developed by bailing.

6.2 Sample Collection

Groundwater sampling was conducted by Dames & Moore personnel on April 17 and 18, 1990. The following procedure was used at each well.

The depth to water from the top of the PVC casing was recorded to the nearest 1/16" using a chalked steel-tape. Standing water was purged from the well using a disposable polyethylene bailer (Voss Technologies). After removing one well volume, field measurements of temperature, pH and specific conductivity were made using a calibrated Hydac meter (Cambridge Scientific Industries) outfitted with an Orion pH probe. Field measurements were taken following each subsequent well-volume purged until three successive sets of measurements fell within the following ranges:

Temperature:	+/- 0.5° C
pH:	+/- 0.1 pH unit
Conductivity:	+/- micromhos

Typically, four (4) or five (5) well volumes were sufficient to accomplish stabilization. Field measurements are summarized in Appendix F. Based on contaminant levels during soil boring activities, purged water was discharged to the ground surface.

Upon stabilization, water samples were collected for laboratory analysis. Table 8 shows the volumes collected and preservations used to constitute one sample.

Samples were shipped via Federal Express to the appropriate laboratories for analysis (MW109 was hand delivered to Envirodyne), under Dames & Moore chain-of-custody procedures (Appendix B). Organic and inorganic samples were shipped in iced coolers. Each day, all VOA sample vials were placed in the same cooler, and were accompanied during shipment by trip blanks (TR-1 and TR-2).

6.3 Investigative Results

Data from organic and inorganic analyses are summarized in Table 9. Data packages from Southwest Laboratories and Envirodyne Engineers are provided in Appendix C. Data from the radiological analyses are summarized in Table 10. Data packages from ITC and CEP are provided in Appendix B.

A review of the organic and inorganic data indicated that pesticides, PCBs, herbicides, and cyanide were not detected. Several VOCs were identified near or below detection levels. Methylene chloride was detected at low levels (1-26 ppb) in all samples analyzed by Southwest. Similarly, acetone was detected (3-17 ppb) in most samples. Both compounds were detected in the Southwest QA/QC method blank, and are frequent laboratory contaminants. The absence of these compounds in the Envirodyne analysis of MW109 (duplicate of both MW102 and MW108), reinforces the interpretation that the methylene chloride and acetone results are not accurate. Low levels of 1-1 dichloroethane are indicated in well MW102 and MW109 (3 ppb and 6 ppb, respectively). Toluene, ethyl benzene, and xylene were indicated in well MW103 in low levels also.

Two BNA (binuclear aromatic) compounds, chrysene and bis (2-ethylhexyl) phthalate, were also indicated in low levels in four (4) of the monitoring wells. Bis (2-ethylhexyl) phthalate was present in MW102, MW105, MW106, and MW109D while chrysene was present only in MW102.

Several metals were detected at low levels as well. Copper and zinc were consistently indicated in samples analyzed by Southwest. Antimony and nickel were also indicated in approximately half of the samples by Southwest. EEI/TCT reported the presence of arsenic, mercury, selenium, and silver in the two samples which they had analyzed (MW109 and MW109D). While there is a wide disparity in the metals results presented by the two laboratories, none of the actual reported quantities are at significant levels to be of concern.

Results of radiological analyses for groundwater samples collected during the Phase II investigation are reported in Tables 10A through 10D. Due to the propensity of groundwater samples collected from wells to contain filterable soil particulates which can skew results, all samples were analyzed as raw unfiltered water and as filtered water using a 0.45 micron filter medium. All results are reported as picocuries per liter of sample plus or minus the 2 sigma associated error. Numbers reported as less than (<) the reported value are below the limit of detectability for the given nuclide and analytical method. All results reported for filtered samples are indistinguishable from background data as represented by the off-site well water results of Table 2 in the Phase I report. Further, the filtered data would easily meet all existing radiological limits established for drinking water by the EPA (40 CFR 141). Of the unfiltered results four samples (MW-103U, MW-105U, MW-106U, and MW-107U) would not meet the EPA gross alpha criteria of 15 pCi/l for drinking water, but would meet all other established limits. However, since raw unfiltered groundwater would not be acceptable as drinking water, this comparison serves no purpose.

7.0 CONCLUSIONS

7.1 Radiological Investigations

7.1.1 Overland Gamma Survey

The results of the overland gamma survey discussed in Section 2 of this report clearly show that all areas surveyed were indistinguishable from ambient radiation levels associated with nearby off-site locations. This conclusion is further supported by the results of the unbiased and composite soil sample analyses which were also indistinguishable from background radionuclide concentrations for the Phase II investigation area.

7.1.2 Soil

As discussed above, all unbiased and composite soil samples collected randomly within the 23 acres area of investigation, were found to have radionuclide concentrations similar to those measured for samples representing ambient (background) conditions collected for the present study, and those collected as background samples for the Phase I investigation. With regard to the two biased samples (B1 and B2) where contamination is evident, refer to Section 7.1.5 for details.

7.1.3 Sediment

Comparison of sediment samples to background soil samples collected for Phase I and II shows that all sediment results reported are less than or equal to the corresponding background concentration with the exception of the gross alpha result reported for sample S4. This sample was subjected to reanalysis of only the gross alpha parameter by ITC and the result reported to Dames & Moore, shown in Table 11, was 19.3 ± 8.6. The original S4 gross alpha value was not confirmed by the reanalysis. This makes the initial analytical result a highly suspect data point, in that, several of the individual nuclides analyzed are alpha emitters, namely U-234, 235/236, 238, thorium-230 and 232 and radium-226. These nuclides are by far the most abundant alpha emitters in nature and therefore their sum should represent the majority of the gross alpha activity present. Because the sum of the individual nuclides is only 7.2 pCi/g, and the analytical techniques used to measure the individual nuclides is more precise than the gross alpha measurement, especially for a medium such as soil, the gross alpha measurement must be considered of secondary importance. Further, naturally occurring nuclides which are decay products of the marker nuclides may add to the gross alpha concentration, but are considered to be in equilibrium with their parent nuclide and therefore would not add significantly to the above calculated alpha contributions of the individual nuclides.

7.1.4 Groundwater

As discussed in Section 6.3, groundwater samples were analyzed as unfiltered and filtered to provide information on the quantity of filterable, and therefore undissolved particulates, resident in the samples. All results reported in Tables 10A through 10D for filtered samples easily meet EPA drinking water standards for gross alpha (15 pCi/l), gross beta (50 pCi/l) and radium-226 + 228 of 5 pCi/l. Further, all unfiltered samples meet these criteria except for the gross alpha values reported for sample MW103-U, 17.2; MW105-U, 16.9; MW106-U, 101; and MW107-U, 202 pCi/l. The gross alpha values reported for these unfiltered samples are also of secondary importance since the sum of the individual nuclide concentrations fail to confirm the gross alpha values (see Section 7.1.3).

Groundwater sample MW102 was also subjected to quality assurance checks having a sample duplicate analyzed and a sample split analyzed by an independent laboratory. The results of both tests confirm the results of the original analysis as reported by IT Corporation. Most values for all tests were reported as below the limit of detection.

7.1.5 Biased Soil Samples

To provide additional characterization of the two limited hot spot areas identified during the Phase I study, the survey team was directed to resurvey the original areas, reidentify the location providing the highest gamma radiation level and remove 2-6" soil samples to a total depth of 12" to provide preliminary characterization of the nuclides present. These data are reported in Tables 4B and 4C.

For Area 1 (Tables 4B) the major nuclides identified as significantly above background are Th-230, Ra-226, U-234, and U-238. These results are confirmed in the sample duplicate analyzed by ITC and in the sample split analyzed by CEP except for Th-230. The discrepancy in the results is due to the differences in analytical techniques used by the two laboratories. Selected analytical results reported for original samples in Table 4B were reanalyzed with results shown in Table II. The reanalysis confirmed the original test results.

For Area 2 (Table 4C), the analytical parameters and major nuclides identified as present in concentrations more than 3 times background were gross alpha, gross beta, Th-230, U-234, U-238, and Ra-226.

Again for sample B2A, as for B1A, the duplicate of the original sample analyzed by ITC confirmed the initial results. The split sample with CEP again did not identify Th-230 in similar quantities, nor were gross alpha and gross beta results reported by CEP similar to the ITC data. Both laboratory technique and measurement capability differences are responsible for these discrepancies. Regardless of the CEP results, any regulatory bodies which would govern clean-up of the area would consider the highest reported results for regulatory purposes and therefore the CEP data splits would become meaningless. Further, this round of soil sampling would only serve to establish the highest potential concentration of nuclides in the area based on surface gamma radiation results. Further area characterization would be required to determine the vertical and horizontal extent of the contamination before clean-up activities could proceed. Due to the elevated levels of uranium-234 and 238 as well as radius-226 in these biased samples it is likely that this material originated from the West Lake Landfill property and found its way to the present location via surface water erosion.

7.2 Inorganic and Organic Chemical Investigation

During the course of the Phase II investigation of the Earth City property, several different classes of both organic and inorganic contaminants were tested for in adjacent surface soils, groundwater, and drainage ditch bottom sediment. Organic contaminants tested for included total petroleum hydrocarbons (TPH), semi-volatile organics, pesticides, PCBs, herbicides, and volatile organics (VOCs). Inorganic contaminants tested for included metals and cyanide.

7.2.1 TPH

Surface soil composite samples (2) collected from areas adjacent to the West Lake Landfill had TPH levels below background. Sediment samples (2) collected from the bottom of a ponded area near the St. Charles Rock Road and from beneath the outlet of a landfill surface water drain, likewise had TPH levels below background.

7.2.2 Semi-volatiles

Low level concentrations (10-50 ppb) of several semi-volatile organic compounds were detected in both surface composite soil samples. Their presence is attributed to the sampling technique, which involved mixing the composite inside a plastic zip-lock bag. Plastic bags of this type often contain residual low level semi-volatiles. The sediment samples likewise contained low level semi-volatiles (10-19 ppb) which can be attributed to sampling technique.

Two semi-volatile BNAs, chrysene and bis (2-ethylhexyl)phthalate were detected in levels near or below detection limits in one and three monitoring wells, respectively, and do not represent a significant environmental concern.

7.2.3 Pesticides, PCBs, Herbicides, Cyanide

There were no detectable levels of any of these contaminants in any of the three sampling media.

7.2.4 VOCs

Volatile organics were tested for only in the eleven (11) groundwater samples. Two (2) VOCs, methylene chloride and acetone, were present in low concentrations in virtually all groundwater samples tested. These samples were analyzed by Southwest Laboratory and both of these VOC components, which are frequent laboratory contaminants, were detected in Southwest's QA/QC method blank. Consequently, this provides further evidence that the results for these contaminants are due to background contamination from the laboratory environment and as such, are not valid.

7.2.5 Metals

For both the soil sample composites (2) and the sediment samples (2), all metals detected do not vary significantly from background levels. Groundwater samples were analyzed by two separate laboratories: Southwest Laboratory and EEI/TCT. Low concentrations of copper, zinc, antimony, and nickel were detected by Southwest while EEI/TCT detected very low levels of arsenic, mercury, selenium, and silver. None of the levels detected represent a significant environmental concern.

SUMMARY OF GAMMA RADIATION FIELD MEASUREMENTS
FOR FORD,EARTH CITY RADIOLOGICAL SURVEY
EARTH CITY, MISSOURI

NORTHERN GRID

SURVEY LOCATIONS

(READINGS ARE IN MICROREM/HOUR AT 1 METER, AND 1 CM ABOVE GROUND SURFACE)

(E&W) / (N&S)	W0	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
N0	5,6	6,6	7,7	5,5	5,6	6,6	7,7	7,7	6,6	6,7	5,5	5,6	8,8	6,7	6,6
N1	5,5	7,6	7,7	5,6	6,6	7,6	6,6	7,7	8,7	7,6	7,7	7,6	6,6	6,7	6,6
N2	7,7	5,5	6,7	6,7	7,7	6,6	7,7	8,8	8,8	8,8	6,6	8,7	6,7	7,7	8,8
N3	5,6	5,6	7,6	5,5	6,6	5,6	6,7	7,7	7,7	7,7	7,7	6,6	7,7	6,6	7,7
N4	S/B	5,5	6,6	5,5	7,7	6,7	7,6	6,7	7,6	5,7	6,6	7,8	7,8	6,7	7,8
N5		S/B	5,6	6,5	5,6	5,5	7,6	6,7	5,4	6,5	6,7	8,7	6,6	7,7	7,7
N6			6,6	5,5	5,5	5,5	6,6	5,8	6,6	6,5	7,8	7,7	7,7	6,6	7,8
N7			S/B	5,5	5,5	5,5	5,5	5,5	6,7	6,8	8,8	7,6	6,7	6,6	6,7
N8				5,5	6,5	5,5	5,6	6,7	5,5	5,5	5,6	6,7	7,7	6,6	7,7
N9				5,5	6,6	5,5	5,5	5,5	5,6	6,6	6,6	6,5	6,6	5,6	7,7
N10				5,5	6,5	5,5	4,5	5,5	5,5	5,5	7,6	7,6	6,7	5,6	5,5
N11				S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B

(E&W) / (N&S)	W15	W16	W17	W18	W19	W20	W21	W22	W23	W24	W25	W26	W27	W28
N0	7,6	7,7	6,7	8,8	7,7	6,7	6,6	7,7	5,5	6,7	7,7	6,7	6,7	6,7
N1	6,7	7,6	7,6	6,6	6,5	6,6	7,7	8,8	7,7	7,8	7,6	5,7	6,7	7,8
N2	6,7	7,8	7,6	7,8	6,7	8,8	6,6	8,8	5,5	7,7	6,6	6,7	8,7	7,7
N3	7,7	6,7	7,7	8,8	6,7	6,8	6,7	7,7	7,8	7,8	7,6	6,7	7,7	5,6
N4	7,7	6,6	6,5	7,7	6,5	7,7	7,8	7,7	5,5	7,8	7,8	7,7	8,7	7,6
N5	6,6	8,8	6,7	6,6	7,7	7,7	6,6	7,7	7,7	6,7	5,5	7,6	8,8	7,7
N6	6,5	5,5	6,5	5,6	8,8	7,7	7,7	7,8	6,7	7,7	7,7	7,6	6,6	7,6
N7	8,7	6,6	7,6	7,7	5,7	5,6	7,7	7,8	7,7	7,7	6,7	6,6	7,6	7,6
N8	7,7	6,6	7,7	6,7	7,8	5,5	8,6	6,6	6,7	6,5	8,7	7,7	7,6	7,7
N9	8,7	5,6	6,7	6,7	7,6	5,6	5,6	7,7	5,6	5,5	6,6	7,7	6,6	7,6
N10	7,6	5,6	6,7	6,6	6,6	6,6	6,6	6,7	5,5	6,6	6,7	6,6	7,7	5,6
N11	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B

(E&W) / (N&S)	W29	W30	W31	W32	W33	W34	W35	W36	W37	W38	W39	W40	W41	W42
N0	7,7	6,7	6,6	6,7	6,7	5,5	6,6	6,7	6,7	6,6	6,5	5,7	6,7	7,6
N1	7,6	7,6	7,7	6,6	5,7	7,7	6,7	6,5	8,8	7,6	7,6	7,6	6,7	5,5
N2	6,6	7,7	7,6	5,6	6,5	8,7	6,6	6,6	6,7	8,8	6,7	5,5	6,7	7,6
N3	7,8	6,7	6,5	6,5	6,7	6,7	5,6	7,6	5,6	6,6	7,7	5,6	6,5	7,7
N4	6,7	5,5	8,7	7,6	7,7	7,6	7,7	6,5	6,6	6,7	6,5	5,5	5,5	7,7
N5	7,7	6,6	6,6	6,6	6,5	7,6	6,6	5,5	6,5	7,8	7,6	6,6	5,5	5,6
N6	6,5	6,6	7,6	7,7	5,5	6,6	7,7	7,6	7,7	7,7	6,7	7,7	6,7	6,5
N7	7,7	7,7	7,7	6,6	7,7	5,5	8,7	7,7	7,6	7,7	7,7	6,5	5,5	5,5
N8	7,7	7,6	5,5	6,5	7,7	5,6	6,5	6,6	6,6	6,5	6,6	6,6	6,5	5,6
N9	6,5	6,6	6,7	6,6	6,6	7,6	7,7	6,6	7,6	7,6	7,7	5,6	5,5	5,5
N10	6,7	6,7	5,5	6,6	6,7	6,6	5,5	6,6	6,6	6,6	5,5	5,5	7,6	5,5
N11	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B	S/B

* S/B = Survey Boundary

SUMMARY OF GAMMA RADIATION FIELD MEASUREMENTS
FOR FORD, EARTH CITY RADIOLOGICAL SURVEY
EARTH CITY, MISSOURI

NORTHWEST GRID

MICROREM/HOUR AT 1 METER, AND 1 CM ABOVE GROUND SURFACE

(E&W)	W0	W12	W25	W50	W60	W70	W80	W90	
(N&S)									
S17	PHASE I SURVEY		LAGOON	PHASE I SURVEY		6,5	6,6	5,5	S/B
S16	AREA		LAGOON	AREA		5,5	7,7	6,6	S/B
S15			LAGOON			6,6	6,6	5,7	S/B
S14			LAGOON			6,7	5,5	6,6	S/B
S13			LAGOON			6,6	6,5	5,5	S/B
S12			LAGOON			6,6	6,6	5,6	S/B
S11			LAGOON			5,5	7,7	5,5	S/B
S10			LAGOON			5,5	6,6	5,5	S/B
S9			LAGOON			5,5	6,6	6,7	S/B
S8			LAGOON			6,6	6,6	5,6	S/B
S7			LAGOON			7,6	6,6	6,7	S/B
S6			LAGOON			6,7	6,6	6,6	S/B
S5			LAGOON			7,8	7,6	6,6	S/B
S4			LAGOON			7,6	7,7	6,7	S/B
S3			LAGOON			5,6	7,7	5,6	S/B
S2			LAGOON			6,5	7,7	5,5	S/B
S1			LAGOON			7,6	7,6	7,7	S/B
S0						5,6	6,5	6,7	S/B
N0	5,6	6,7		7,6	6,5	8,6	6,7	S/B	
N1	5,6	7,6	LAGOON	6,6	6,5	7,6	6,6	S/B	
N2	5,5	7,7	LAGOON	7,7	7,7	7,7	6,7	S/B	
N3	5,6	6,7	LAGOON	5,7	6,7	7,6	7,6	S/B	
N4	5,7	7,7	LAGOON	6,6	5,5	6,6	6,7	S/B	
N5	6,6	6,8	LAGOON	6,5	6,5	6,5	7,8	S/B	
N6	6,5	8,6	LAGOON	7,7	5,5	7,7	5,5	S/B	
N7	6,6	6,6	LAGOON	7,7	6,6	6,8	6,6	S/B	
N8	6,5	7,8	LAGOON	6,6	6,7	7,6	5,6	S/B	
N9	5,5	6,6	LAGOON	7,7	7,7	6,6	6,5	S/B	
N10	6,7	8,7	LAGOON	7,7	6,5	7,7	5,6	S/B	
N11	7,7	7,7	LAGOON	5,6	6,6	7,6	7,7	S/B	
N12	6,7	7,7	LAGOON	5,5	7,8	5,5	7,8	S/B	
N13	5,6	6,7	LAGOON	5,5	6,7	6,6	5,5	S/B	
N14	6,6	8,6	LAGOON	7,7	7,7	7,6	6,6	S/B	
	S/B	S/B		S/B	S/B	S/B	S/B		

Table 1C

SUMMARY OF GAMMA RADIATION FIELD MEASUREMENTS
FOR FORD, EARTH CITY RADIOLOGICAL SURVEY
EARTH CITY, MISSOURI

WESTERN GRID

MICROREM/HOUR AT 1 METER, AND 1 CM ABOVE GROUND SURFACE

(E&W)	W0	W15	W25	W36	W46	
(N&S)						S/B
N0	5,5	6,5	LAGOON	5,5	7,6	S/B
N1	5,5	6,5	LAGOON	6,7	6,5	S/B
N2	5,5	6,6	LAGOON	5,5	6,7	S/B
N3	6,6	6,5	LAGOON	7,6	7,7	S/B
N4	6,6	6,6	LAGOON	6,5	5,5	S/B
N5	5,5	7,6	LAGOON	5,5	7,6	S/B
N6	6,5	6,5	LAGOON	5,5	8,7	S/B
N7	5,5	5,5	LAGOON	7,7	7,6	S/B
N8	5,6	6,5	LAGOON	7,8	7,7	S/B
N9	5,5	7,6	LAGOON	5,6	6,7	S/B
N10	5,5	6,6	LAGOON	5,7	7,8	S/B
N11	6,6	7,6	LAGOON	6,7	6,7	S/B
N12	5,5	6,6	LAGOON	7,7	5,5	S/B
N13	4,5	6,6	LAGOON	7,6	5,6	S/B
N14	4,4	7,7	LAGOON	5,6	5,5	S/B
N15	5,6	7,6	LAGOON	6,6	6,5	S/B
N16	6,6	6,5	LAGOON	5,6	7,6	S/B
N17	6,5	6,6	LAGOON	5,5	6,5	S/B
N18	6,6	7,6	LAGOON	7,6	5,5	S/B
N19	6,6	8,7	LAGOON	6,7	5,5	S/B
N20	5,6	6,5	LAGOON	7,6	5,6	S/B
N21	5,6	6,5	LAGOON	5,6	7,8	S/B
N22	5,5	6,6	LAGOON	5,6	6,6	S/B
N23	6,5	7,7	LAGOON	5,5	6,7	S/B
N24	5,6	8,7	LAGOON	5,5	7,6	S/B
N25	5,5	5,5	LAGOON	5,5	6,6	S/B
N26	6,5	6,6	LAGOON	5,5	7,7	S/B
N27	5,5	7,7	LAGOON	8,7	6,6	S/B
N28	4,4	6,6	LAGOON	7,6	7,7	S/B
N29	4,5	5,5	LAGOON	6,6	7,6	S/B
N30	6,5	6,6	LAGOON	7,6	6,7	S/B
N31	5,5	6,6	LAGOON	7,6	7,6	S/B
N32	5,6	7,6	LAGOON	6,6	7,7	S/B
N33	5,5	7,6	LAGOON	6,6	6,7	S/B
N34	5,4	6,6	LAGOON	7,7	5,5	S/B
N35	4,4	7,7	LAGOON	6,6	7,7	S/B
N36	4,4	6,6	LAGOON	7,7	5,5	S/B
N37	5,5	7,6	LAGOON	6,6	6,7	S/B
N38	4,4	5,5	LAGOON	6,7	5,5	S/B
N39	5,4	6,6	LAGOON	8,6	6,7	S/B
N40	6,6	7,6	LAGOON	7,7	5,6	S/B
N41	5,6	5,5	LAGOON	6,6	6,6	S/B
N42	4,5	5,5	LAGOON	7,6	5,5	S/B
N43	4,5	5,5	LAGOON	6,6	6,7	S/B
N44	5,5	6,5	LAGOON	7,8	5,5	S/B
N45	5,5	6,6	LAGOON	7,6	7,6	S/B
N46	4,5	6,7	LAGOON	6,5	6,6	S/B
N47	5,5	6,6	LAGOON	6.7	6,5	S/B
N48	5,5	6,7	LAGOON	6,5	7,7	S/B
N49	6,5	6,6	LAGOON	7,7	6,5	S/B
N50	5,5	6,5	LAGOON	6.5	6,6	S/B
N51	6,6	5,5	LAGOON	7,7	7,6	S/B
N52	6,5	6,5	LAGOON	7,7	6,6	S/B
N53	6,5	5,5	LAGOON	7,6	7,6	S/B
N54	5,4	7,7	LAGOON	7,7	5,5	S/B
N55	5,5	6,6	LAGOON	5,5	5,6	S/B
	S/B	S/B	S/B	S/B	S/B	

Table 2
Volumes & Preservatives
Soil & Sediment Samples

Parameters	No.	Size	Type	Preserv
TPH	1	100 ml	glass	none
Semivolatiles Pesticides Herbicides	1	500 ml	glass	none
Metals Cyanide	1	200 ml	polyethylene	none
Radiologic	1	500 gram	plastic bag	none

Table 3
Organic & Inorganic Data Summary
Soil Samples

Parameter	**Units**	**BKG**	**COMP1**	**COMP2**
TPH	mg/kg	ND	ND	ND
TPH - Misc	mg/kg	14.9	5.1	5.1
Semivolatiles				
Benzoic Acid	ug/kg	ND	ND	30
2-Methylnaphthalene	ug/kg	ND	ND	10
Phenanthrene	ug/kg	ND	ND	30
Di-n-butylphthalate	ug/kg	ND	ND	50
Fluoranthrene	ug/kg	ND	30	50
Pyrene	ug/kg	ND	30	30
Butylbenzylphthalate	ug/kg	ND	ND	ND
Bis(2-Ethylhexyl)phthalate	ug/kg	ND	ND	ND
Pesticides/PCBs	ug/kg	ND	ND	ND
Herbicides	ug/kg	ND	ND	ND
Metals				
Arsenic	mg/kg	5.8	5.89	7.41
Lead	mg/kg	17.4	13.6	15.9
Mercury	mg/kg	ND	ND	ND
Selenium	mg/kg	ND	ND	ND
Thallium	mg/kg	ND	ND	ND
Antimony	mg/kg	6.9	ND	7.4
Beryllium	mg/kg	ND	ND	ND
Cadmium	mg/kg	1.1	ND	ND
Chromium	mg/kg	14.5	18.1	15.5
Copper	mg/kg	24.0	22.8	25.0
Nickel	mg/kg	18.0	18.3	19.2
Silver	mg/kg	ND	ND	ND
Zinc	mg/kg	61.6	62.4	57.4
Cyanide	ug/kg	ND	ND	ND

Table 4A
Radiologic Data Summary
Unbiased Soil Samples

Parameter	Units	BKG	UB1	UB2	UB3	UB4	UB5	UB6
Type		Background	investigative	investigative	investigative	investigative	investigative	investigative
Depth		0-6"	0-6"	0-6"	0-6"	0-6"	0-6"	0-6"
Laboratory		ITC	ITC	ITC	ITC	ITC	ITC	ITC
Gross Alpha	pCi/g	33.0 +/- 11.4	23.6 +/- 9.9	26.0 +/- 10.1	25.8 +/- 10.1	20.0 +/- 8.5	18.3 +/- 8.3	27.5 +/- 9.9
Gross Beta	pCi/g	27.9 +/- 9.6	23.5 +/- 8.5	30.0 +/- 11.1	31.1 +/- 10.9	29.0 +/- 9.9	25.6 +/- 9.7	25.1 +/- 8.0
Uranium-234	pCi/g	1.1 +/- 0.3	1.3 +/- 0.3	1.2 +/- 0.3	0.9 +/- 0.2	1.0 +/- 0.2	1.3 +/- 0.3	1.2 +/- 0.3
Uranium 235/236	pCi/g	< 0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Uranium 238	pCi/g	1.1 +/- 0.3	1.0 +/- 0.2	1.2 +/- 0.3	0.9 +/- 0.2	0.7 +/- 0.2	1.0 +/- 0.2	1.2 +/- 0.3
Thorium 230	pCi/g	3.6 +/- 0.6	2.5 +/- 0.5	1.8 +/- 0.4	2.2 +/- 0.5	2.1 +/- 0.4	3.0 +/- 0.7	2.5 +/- 0.5
Thorium-232	pCi/g	1.5 +/- 0.3	1.0 +/- 0.3	1.2 +/- 0.3	1.2 +/- 0.3	1.1 +/- 0.3	1.6 +/- 0.4	1.2 +/- 0.3
Potassium-40	pCi/g	18.1 +/- 2.9	9.9 +/- 1.4	11.7 +/- 1.6	14.6 +/- 1.9	17.7 +/- 2.9	18.6 +/- 3.0	19.7 +/- 3.2
Cesium-137	pCi/g	< 0.2	0.3 +/- 0.05	0.3 +/- 0.06	0.2 +/- 0.06	<0.2	<0.2	0.2 +/- 0.05
Radium-226	pCi/g	1.1 +/- 0.1	1.0 +/- 0.1	1.2 +/- 0.1	1.2 +/- 0.1	1.1 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1
Radium-228	pCi/g	1.3 +/- 0.2	1.1 +/- 0.1	1.2 +/- 0.2	1.2 +/- 0.2	1.4 +/- 0.2	1.6 +/- 0.2	1.5 +/- 0.2

Table 48
Radiologic Data Summary
Area B1 Biased Soil Samples

Parameter	Units	BKG	B1A	B1A	B1B	B1C		
Type		Background	investigative	split of B1A	dupl. of B1A	investigative		
Depth		0-6"	0-6"	0-6"	0-6"	6-12"		
Laboratory		ITC	ITC	CEP	ITC	ITC		
Gross Alpha	pCi/g	33.0 +/- 11.4	1650 +/- 340	44.6 +/- 1.8	1980 +/- 400	1810 +/- 370		
Gross Beta	pCi/g	27.9 +/- 9.6	313 +/- 66	21.2 +/- 0.6	304 +/- 64	274 +/- 58		
Uranium-234	pCi/g	1.1 +/- 0.3	7.9 +/- 1.0	4.2 +/- 0.5	6.3 +/- 1.1	7.4 +/- 1.0		
Uranium 235/236	pCi/g	< 0.6	<0.6	0.6 +/- 0.2	<0.6	<0.6		
Uranium 238	pCi/g	1.1 +/- 0.3	6.9 +/- 0.9	1.6 +/- 0.3	6.3 +/- 1.1	7.0 +/- 1.0		
Thorium 230	pCi/g	3.6 +/- 0.6	1580 +/- 370	<0.2	1390 +/- 270	1430 +/- 360		
Thorium-232	pCi/g	1.5 +/- 0.3	5.1 +/- 1.6	1.0 +/- 0.2	4.1 +/- 1.1	6.7 +/- 2.2		
Potassium-40	pCi/g	18.1 +/- 2.9	12.4 +/- 2.2	11.1 +/- 1.4	6.8 +/- 1.5	11.6 +/- 2.0		
Cesium-137	pCi/g	< 0.2	<0.2	0.1 +/- 0.1	<0.2	0.3 +/- 0.1		
Radium-226	pCi/g	1.1 +/- 0.1	39.5 +/- 3.3	41.4 +/- 0.4	29.6 +/- 4.5	24.0 +/- 3.7		
Radium-228	pCi/g	1.3 +/- 0.2	1.0 +/- 0.3	<0.1	1.0 +/- 0.3	1.3 +/- 0.3		

Table 4C
Radiologic Data Summary
Area B2 Biased Soil Samples

Parameter	Units	BKG	B2A	B2A	B2B	B2C		
Type		Background	investigative	split of B2A	dupl. of B2A	investigative		
Depth		0-6"	0-6"	0-6"	0-6"	6-12"		
Laboratory		ITC	ITC	CEP	ITC	ITC		
Gross Alpha	pCi/g	33.0 +/- 11.4	7810 +/- 1570	199 +/- 2.4	5560 +/ 1120	1080 +/- 220		
Gross Beta	pCi/g	27.9 +/- 9.6	969 +/- 197	34.5 +/- 0.5	776 +/- 159	149 +/- 35		
Uranium-234	pCi/g	1.1 +/- 0.3	18.0 +/- 2.4	14.4 +/- 0.8	11.3 +/- 1.5	2.0 +/- 0.3		
Uranium 235/236	pCi/g	< 0.6	2.1 +/- 0.4	0.2 +/- 0.1	<0.6	0.7 +/- 0.2		
Uranium 238	pCi/g	1.1 +/- 0.3	11.4 +/- 1.6	2.4 +/- 0.3	6.5 +/- 0.9	2.1 +/- 0.4		
Thorium 230	pCi/g	3.6 +/- 0.6	3720 +/- 780	<0.2	2820 +/- 580	574 +/- 113		
Thorium-232	pCi/g	1.5 +/- 0.3	4.5 +/- 1.3	1.3 +/- 0.5	13.1 +/- 3.0	1.2 +/- 0.5		
Potassium-40	pCi/g	18.1 +/- 2.9	9.4 +/- 1.8	9.2 +/- 3.3	9.2 +/- 1.7	9.5 +/- 1.6		
Cesium-137	pCi/g	< 0.2	<0.2	<0.1	<0.2	<0.2		
Radium-226	pCi/g	1.1 +/- 0.1	15.1 +/- 1.9	132 +/- 8.0	59.3 +/- 4.7	9.9 +/- 1.6		
Radium-228	pCi/g	1.3 +/- 0.2	1.3 +/- 0.4	150 +/- 38	1.2 +/- 0.3	1.0 +/- 0.2		

Table 4D
Radiologic Data Summary
Composite Soil Samples

Parameter	Units	BKG	COMP1	COMP2				
Type		Background	investigative	investigative				
Depth		0-6"	0-6"	0-6"				
Laboratory		ITC	ITC	ITC				
Gross Alpha	pCi/g	33.0 +/- 11.4	15.0 +/- 7.1	18.4 +/- 8.2				
Gross Beta	pCi/g	27.9 +/- 9.6	25.5 +/- 10.1	21.8 +/- 9.8				
Uranium-234	pCi/g	1.1 +/- 0.3	1.0 +/- 0.3	1.0 +/- 0.2				
Uranium 235/236	pCi/g	< 0.6	<0.6	<0.6				
Uranium 238	pCi/g	1.1 +/- 0.3	1.0 +/- 0.3	0.8 +/- 0.2				
Thorium 230	pCi/g	3.6 +/- 0.6	2.2 +/- 0.5	2.4 +/- 0.4				
Thorium-232	pCi/g	1.5 +/- 0.3	1.3 +/- 0.3	1.2 +/- 0.3				
Potassium-40	pCi/g	18.1 +/- 2.9	10.1 +/- 1.4	18.2 +/- 2.9				
Cesium-137	pCi/g	< 0.2	<0.2	<0.2				
Radium-226	pCi/g	1.1 +/- 0.1	1.1 +/- 0.1	1.2 +/- 0.1				
Radium-228	pCi/g	1.3 +/- 0.2	1.2 +/- 0.2	1.3 +/- 0.2				

Table 5
Organic & Inorganic Data Summary
Sediment Samples

Parameter	Units	BKG	S3	S4
TPH	mg/kg	ND	ND	ND
TPH - Misc	mg/kg	14.9	12.0	6.3
Semivolatiles				
Benzoic Acid	ug/kg	ND	35	140
2-Methylnaphthalene	ug/kg	ND	ND	ND
Phenanthrene	ug/kg	ND	30	40
Di-n-butylphthalate	ug/kg	ND	10	100
Fluoranthrene	ug/kg	ND	40	ND
Pyrene	ug/kg	ND	50	30
Butylbenzylphthalate	ug/kg	ND	ND	50
Bis(2-Ethylhexyl)phthalate	ug/kg	ND	ND	190
Pesticides/PCBs	ug/kg	ND	ND	ND
Herbicides	ug/kg	ND	ND	ND
Metals				
Arsenic	mg/kg	5.8	2.12	5.6
Lead	mg/kg	17.4	12.4	17.8
Mercury	mg/kg	ND	ND	0.18
Selenium	mg/kg	ND	ND	ND
Thallium	mg/kg	ND	ND	ND
Antimony	mg/kg	6.9	ND	6.7
Beryllium	mg/kg	ND	ND	ND
Cadmium	mg/kg	1.1	ND	ND
Chromium	mg/kg	14.5	5.5	13.1
Copper	mg/kg	24.0	15.2	23.0
Nickel	mg/kg	18.0	9.7	16.3
Silver	mg/kg	ND	ND	ND
Zinc	mg/kg	61.6	32.8	56.8
Cyanide	ug/kg	ND	ND	ND

Table 6
Radiologic Data Summary
Sediment Samples

Parameter	Units	BKG	S1	S2	S3	S4
Type		Background	investigative	investigative	investigative	investigative
Depth		0-6"	0-6"	0-6"	0-6"	0-18"
Laboratory		ITC	ITC	ITC	ITC	ITC
Gross Alpha	pCi/g	33.0 +/- 11.4	32.1 +/- 11.8	17.4 +/- 7.7	23.2 +/- 9.1	219 +/- 50
Gross Beta	pCi/g	27.9 +/- 9.6	26.7 +/- 11.0	25.7 +/- 9.1	17.9 +/- 7.6	27.3 +/ 9.4
Uranium-234	pCi/g	1.1 +/- 0.3	1.0 +/- 0.3	1.0 +/- 0.3	0.7 +/- 0.2	1.1 +/ 0.3
Uranium 235/236	pCi/g	< 0.6	<0.6	<0.6	<0.6	<0.6
Uranium 238	pCi/g	1.1 +/- 0.3	0.9 +/- 0.2	1.1 +/- 0.3	0.8 +/- 0.2	0.6 +/- 0.2
Thorium 230	pCi/g	3.6 +/- 0.6	1.3 +/- 0.3	2.3 +/- 0.4	2.6 +/- 0.4	2.4 +/- 0.5
Thorium-232	pCi/g	1.5 +/- 0.3	1.0 +/- 0.3	1.2 +/- 0.3	0.7 +/- 0.2	1.1 +/- 0.3
Potassium-40	pCi/g	18.1 +/- 2.9	17.7 +/- 3.0	5.1 +/- 1.0	10.2 +/- 1.4	10.9 +/- 1.5
Cesium-137	pCi/g	< 0.2	<0.2	.07 +/- .03	<0.2	<0.2
Radium-226	pCi/g	1.1 +/- 0.1	1.2 +/- 0.2	1.2 +/- 0.1	0.8 +/- 0.1	1.2 +/- 0.1
Radium-228	pCi/g	1.3 +/- 0.2	1.2 +/- 0.3	1.3 +/- 0.2	0.6 +/- 0.1	1.3 +/- 0.2

TABLE 7

FORD (EARTH CITY), PHASE II PROPERTY EVALUATION
DOWNHOLE GAMMA LOGGING RESULTS

DEPTH (6" INTERVALS)		UNITS[1]	WELL MW-101	WELL MW-102	WELL MW-103	WELL MW-104	WELL MW-105	WELL MW-106	WELL MW-107
6	A	CNTS/MIN	3600	4000	4000	3900	3700	3800	3600
12	B	CNTS/MIN	4000	4200	4000	4200	3600	3800	4000
18	C	CNTS/MIN	4000	4200	4000	4400	3800	3800	3600
24	D	CNTS/MIN	4000	4200	4000	4400	4000	4400	3800
30	E	CNTS/MIN	4200	4300	3200	4500	4000	4400	3800
36	F	CNTS/MIN	4000	4200	4000	4700	4000	4000	3600
42	G	CNTS/MIN	4000	4200	4000	4500	4000	4000	3800
48	H	CNTS/MIN	3600	3900	4000	4000	4300	4000	3400
54	I	CNTS/MIN	3400	3700	4000	3300	4000	4000	3400
60	J	CNTS/MIN	4000	3800	4000	4000	3500	3200	3800
66	K	CNTS/MIN	4000	4000	4000	4000	3600	4200	3800
72	L	CNTS/MIN	3800	3700	4000	4300	3800	4400	4000
78	M	CNTS/MIN	3700	3700	4000	4300	3800	4400	4000
84	N	CNTS/MIN	3700	3700	4000	4300	3700	4400	4200
90	O	CNTS/MIN	3500	3800	4000	4000	3800	4200	4000
96	P	CNTS/MIN	3600	3700	3100	4000	4000	4000	4200
102	Q	CNTS/MIN	3400	3700	3400	4000	4000	4200	4000
108	R	CNTS/MIN	3400	3700	4000	4000	4000	4000	WATER
114	S	CNTS/MIN	3200	3600	4000	3300	3300	4000	
120	T	CNTS/MIN	3500	3300	3600	3600	3600	WATER	
126	U	CNTS/MIN	3400	3200	3700	3900	3900		
132	V	CNTS/MIN	3400	3000	3400	3900	3900		
138	W	CNTS/MIN	3500	3000	3600	3700	3700		
144	X	CNTS/MIN	3600	3000	3600	3700	3700		
150	Y	CNTS/MIN	3400	3000	WATER	WATER	WATER		
156	Z	CNTS/MIN	3300	3000					
162	AA	CNTS/MIN	WATER	3100					
168	AB	CNTS/MIN		3100					
174	AC	CNTS/MIN		WATER					

1 Readings are in gross counts per minute without background subtracted.

Table 8
Volumes & Preservatives
Water Samples

Parameters	No.	Size	Type	Preserv
VOAs	2	40 ml	glass	HCl
Semivolatiles	1	2 liter	amber glass	none
Pesticides/PCBs	1	1 liter	amber glass	none
Herbicides	1	1 liter	amber glass	none
Metals	1	250 ml	polyethylene	HNO_3
Cyanide	1	500 ml	polyethylene	NaOH
Radiologic (Filtered)	1	4 liter	plastic	HNO_3
Radiologic (Unfiltered)	1	4 liter	plastic	HNO_3

Table 9
Organic & Inorganic Data Summary
Water Samples

PARAMETER	UNITS	MW-101	MW-102	MW-103	MW-104	MW-105	MW-106	MW-107	MW-108	MW-109	MW-109D	MW-110
Type		inv	inv	inv	inv	inv	inv	inv	102	102	102	rinse
Laboratory		SW	SW	SW	SW	SW	SW	SW	SW	EEI	EEI	SW
VOCs (selected)												
Methylene Chloride	ppb	18 B	16 B	26 B	1 JB	18 B	19 B	16 B	15 B	ND	ND	16 B
Acetone	ppb	5 J	ND	17 B	5 JB	6 J	4 J	3 J	ND	ND	ND	4 JB
1-1 Dichloroethane	ppb	ND	3 J	ND	ND	ND	ND	ND	ND	6	ND	ND
1-1 Dichloroethene	ppb	ND	ND	ND	ND	ND	ND	ND	3 J	ND	ND	ND
Toluene	ppb	ND	ND	8	ND	ND	ND	ND	ND	ND	ND	ND
Ethyl Benzene	ppb	ND	ND	2 J	ND	ND	ND	ND	ND	ND	ND	ND
Xylene	ppb	ND	ND	10	ND	ND	ND	ND	ND	ND	ND	ND
Semivolatiles (selected)												
Di-ethylphthalate	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	8 J
Bis(2-ethylhexyl)phthalate	ppb	ND	2 JB	ND	ND	2 J	27	ND	ND	ND	14	ND
Chrysene	ppb	ND	1 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pesticides/PCBs	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Herbicides	ppb	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Metals (selected)												
Antimony	ppb	ND	ND	34.5	ND	ND	44.7	33.1	34.5	ND	ND	ND
Arsenic	ppb	ND	ND	ND	ND	ND	ND	ND	ND	3.1	2.5	ND
Copper	ppb	152	326	43	131	73	80	62	81	ND	ND	102
Mercury	ppb	ND	ND	ND	ND	ND	ND	ND	ND	0.48	ND	ND
Nickel	ppb	ND	13.8	ND	ND	ND	ND	10.9	14	ND	ND	ND
Selenium	ppb	ND	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND
Silver	ppb	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND
Zinc	ppb	102	52.8	34.1	40.7	489	56.4	43	44.5	ND	ND	40.5
Cyanide	ppm	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table 10A
Radiologic Data Summary
Water Samples

Parameter	Units	MW101-U	MW101-F	MW102-U	MW102-F	MW103-U	MW103-F
Type		investigative	investigative	investigative	investigative	investigative	investigative
		Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
Laboratory		ITC	ITC	ITC	ITC	ITC	ITC
Gross Alpha	pCi/l	< 10.0	< 7.7	< 8.1	< 2.3	17.2 +/- 9.6	< 7.0
Gross Beta	pCi/l	24.1 +/- 8.4	9.5 +/- 6.3	7.1 +/- 5.5	< 8.4	23.4 +/- 10.1	<13.4
Uranium-234	pCi/l	9.1 +/- 1.8	1.3 +/- 0.3	1.4 +/- 0.4	2.4 +/- 0.6	1.3 +/- 0.2	5.1 +/- 0.9
Uranium 235/236	pCi/l	1.4 +/- 0.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Uranium 238	pCi/l	8.6 +/- 1.7	< 1.0	1.3 +/- 0.4	1.6 +/- 0.5	1.2 +/- 0.2	3.6 +/- 0.7
Thorium 230	pCi/l	1.0 +/- 0.4	< 1.0	< 1.0	< 1.0	1.2 +/- 0.5	1.6 +/- 0.5
Thorium-232	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Potassium-40	pCi/l	<130	<160	<140	<180	<150	<180
Cesium-137	pCi/l	< 20	< 20	< 20	< 20	< 20	< 20
Radium-226	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Radium-228	pCi/l	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

Table 10B
Radiologic Data Summary
Water Samples

Parameter	Units	MW104-U	MW104-F	MW105-U	MW105-F	MW106-U	MW106-F
Type		investigative	investigative	investigative	investigative	investigative	investigative
		Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
Laboratory		ITC	ITC	ITC	ITC	ITC	ITC
Gross Alpha	pCi/l	11.4 +/- 7.4	< 2.0	16.9 +/- 8.3	< 10.1	101 +/- 23	< 10.2
Gross Beta	pCi/l	18.7 +/- 7.4	< 8.3	14.5 +/- 9.1	7.32 +/- 5.6	29.5 +/- 12.2	< 16.0
Uranium-234	pCi/l	3.8 +/- 0.7	2.0 +/- 0.5	< 1.0	1.3 +/- 0.3	2.2 +/- 0.5	3.8 +/- 0.6
Uranium 235/236	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Uranium 238	pCi/l	2.7 +/- 0.6	1.1 +/- 0.4	< 1.0	< 1.0	1.4 +/- 0.4	2.7 +/- 0.5
Thorium 230	pCi/l	2.0 +/- 0.6	< 1.0	< 1.0	< 1.0	4.5 +/- 1.2	< 1.0
Thorium-232	pCi/l	1.5 +/- 0.6	< 1.0	< 1.0	< 1.0	6.1 +/- 1.5	< 1.0
Potassium-40	pCi/l	<140	104 +/- 60	145 +/- 74	<140	283 +/- 114	<140
Cesium-137	pCi/l	< 20	< 20	< 20	< 20	< 20	< 20
Radium-226	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	1.4 +/- 0.3	1.1 +/- 0.3
Radium-228	pCi/l	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0

Table 10C
Radiologic Data Summary
Water Samples

Parameter	Units	MW107-U	MW107-F	MW108-U	MW108-F	MW109-U	MW109-F
Type		investigative	investigative	dupl. MW102-U	dupl. MW102-F	split MW102-U	split MW102-F
		Unfiltered	Filtered	Unfiltered	Filtered	Unfiltered	Filtered
Laboratory		ITC	ITC	ITC	ITC	CEP	CEP
Gross Alpha	pCi/l	202 +/- 36	< 10	< 7.5	< 10.6	< 2.0	< 2.0
Gross Beta	pCi/l	17.7 +/- 11.0	< 9.3	< 10.3	< 8.4	7 +/- 3	< 3
Uranium-234	pCi/l	< 1.0	1.6 +/- 0.4	2.2 +/- 0.5	3.6 +/- 0.6	< 0.6	< 0.6
Uranium 235/236	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	< 0.6	< 0.6
Uranium 238	pCi/l	< 1.0	1.2 +/- 0.3	1.7 +/- 0.4	2.9 +/- 0.5	< 0.6	< 0.6
Thorium 230	pCi/l	< 1.0	< 1.0	1.6 +/- 0.6	< 1.0	< 0.6	< 0.6
Thorium-232	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	< 0.6	< 0.6
Potassium-40	pCi/l	<180	<180	<190	<150	< 5	< 5
Cesium-137	pCi/l	< 20	< 20	< 20	< 20	11.0 +/- 0.8	< 2
Radium-226	pCi/l	< 1.0	< 1.0	< 1.0	< 1.0	1.5 +/- 1.0	< 0.6
Radium-228	pCi/l	< 3.0	< 3.0	< 3.0	< 3.0	< 1	< 1

Table 10D
Radiologic Data Summary
Water Samples

Parameter	Units	MW110-U	MW110-F		WAT		
Type		rinse	rinse		soil rinse		
		Unfiltered	Filtered				
Laboratory		ITC	ITC		ITC		
Gross Alpha	pCi/l	< 1.0	< 1.0				
Gross Beta	pCi/l	< 4.0	< 4.0				
Uranium-234	pCi/l	< 1.0	< 1.0				
Uranium 235/236	pCi/l	< 1.0	< 1.0				
Uranium 238	pCi/l	< 1.0	< 1.0				
Thorium 230	pCi/l	< 1.0	< 1.0				
Thorium-232	pCi/l	< 1.0	< 1.0				
Potassium-40	pCi/l	<100	<190				
Cesium-137	pCi/l	< 20	< 20				
Radium-226	pCi/l	< 1.0	< 1.0				
Radium-228	pCi/l	< 3.0	< 3.0				

TABLE 11

SAMPLE REANALYSIS DATA

Sample ID	Type	Parameter(s) Reanalyzed	Date	Results ± 2G (units)
S4	Sediment	Gross alpha	5/25/90	19.3 ± 8.6 (pCi/g)
B1A	Soil	Gross alpha Gross beta Thorium-230	5/25/90 5/25/90 6/07/90	1140 ± 240 (pCi/g) 250 ± 53 (pCi/g) 1750 ± 360 (pCi/g)
B2A	Soil	Gross alpha Gross beta Thorium-230 Radium-226 Radium-228	5/25/90 5/25/90 6/07/90 5/25/90 5/25/90	4100 ± 830 (pCi/g) 627 ± 129 (pCi/g) 3530 ± 970 (pCi/g) 89.5 ± 4.7 (pCi/g) < 1.16 (pCi/g)
MW106-U	Groundwater	Gross alpha	5/25/90	307 ± 133 (pCi/g)

D&M Job No. 19943-002-045
June 14, 1990

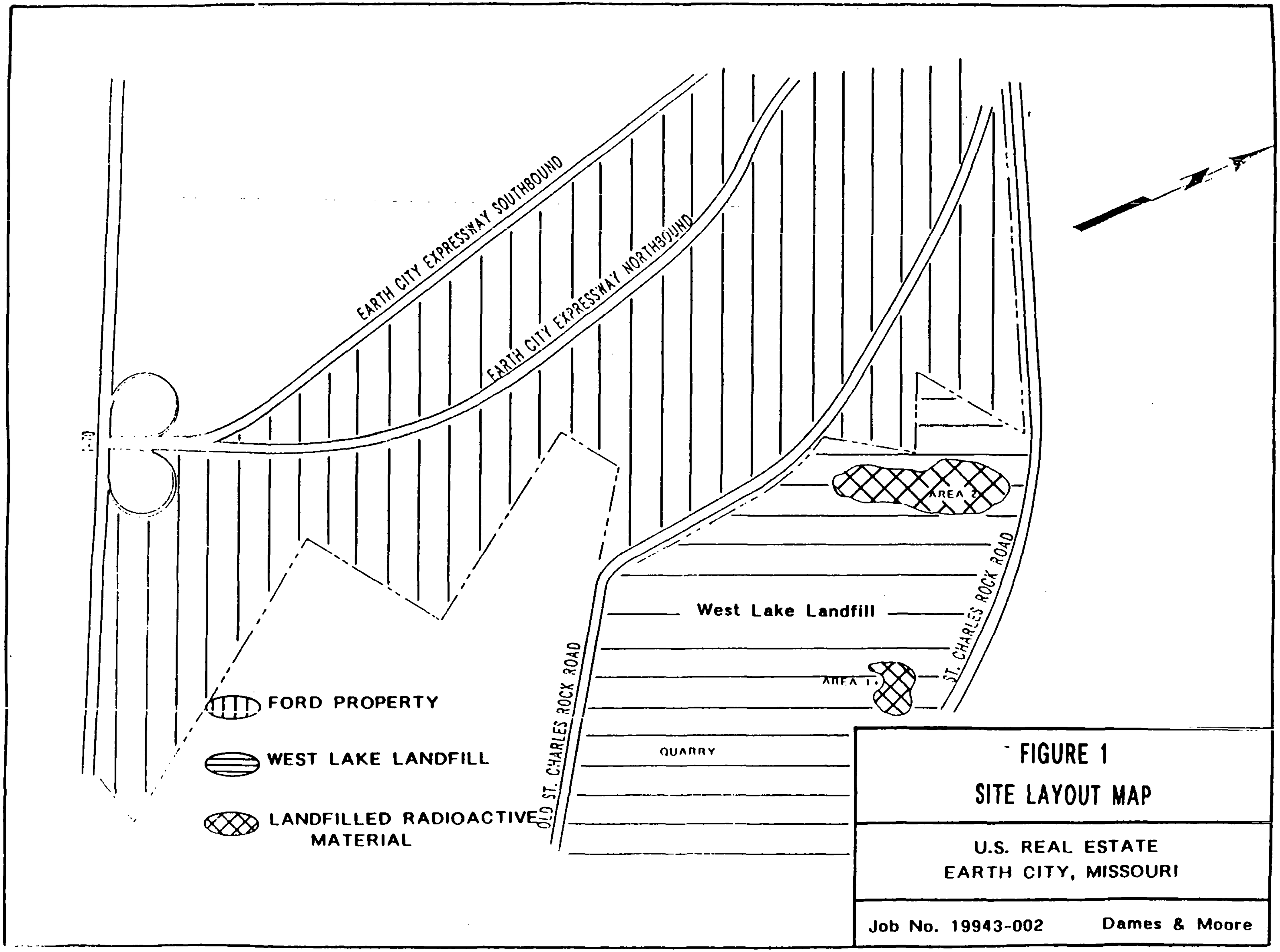

FIGURE 1
SITE LAYOUT MAP

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

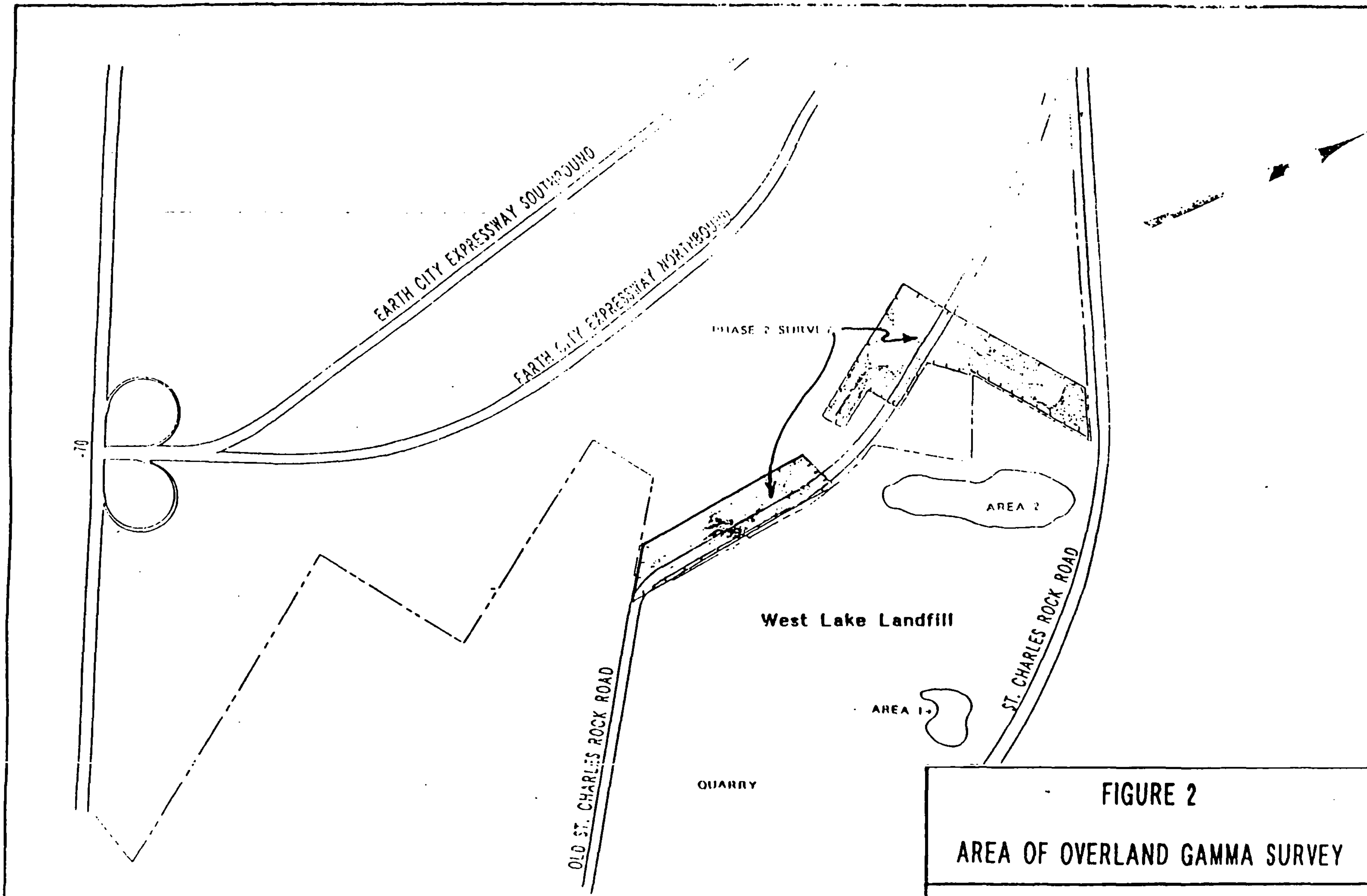

FIGURE 2

AREA OF OVERLAND GAMMA SURVEY

U.S. REAL ESTATE

EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

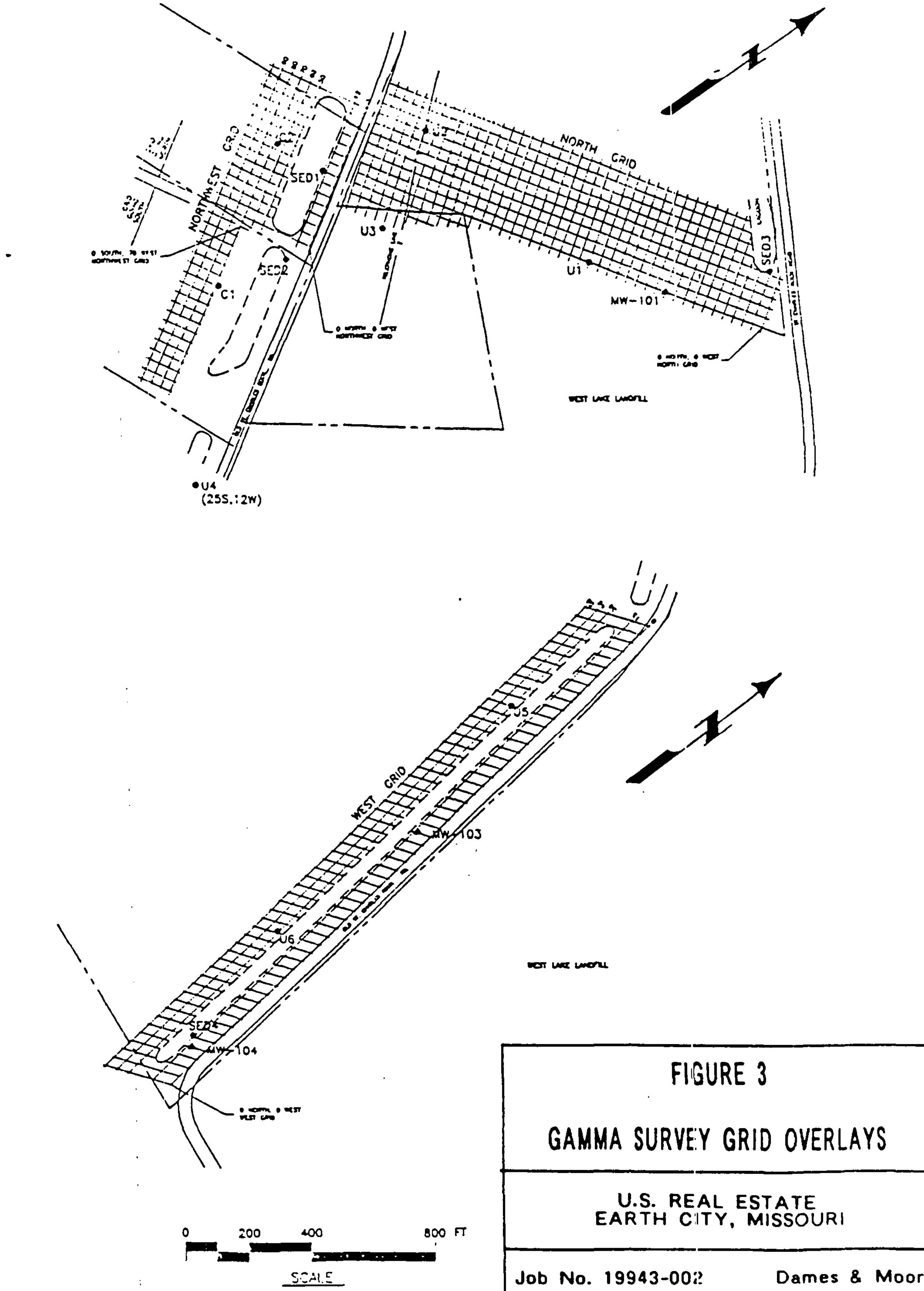

FIGURE 3

GAMMA SURVEY GRID OVERLAYS

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

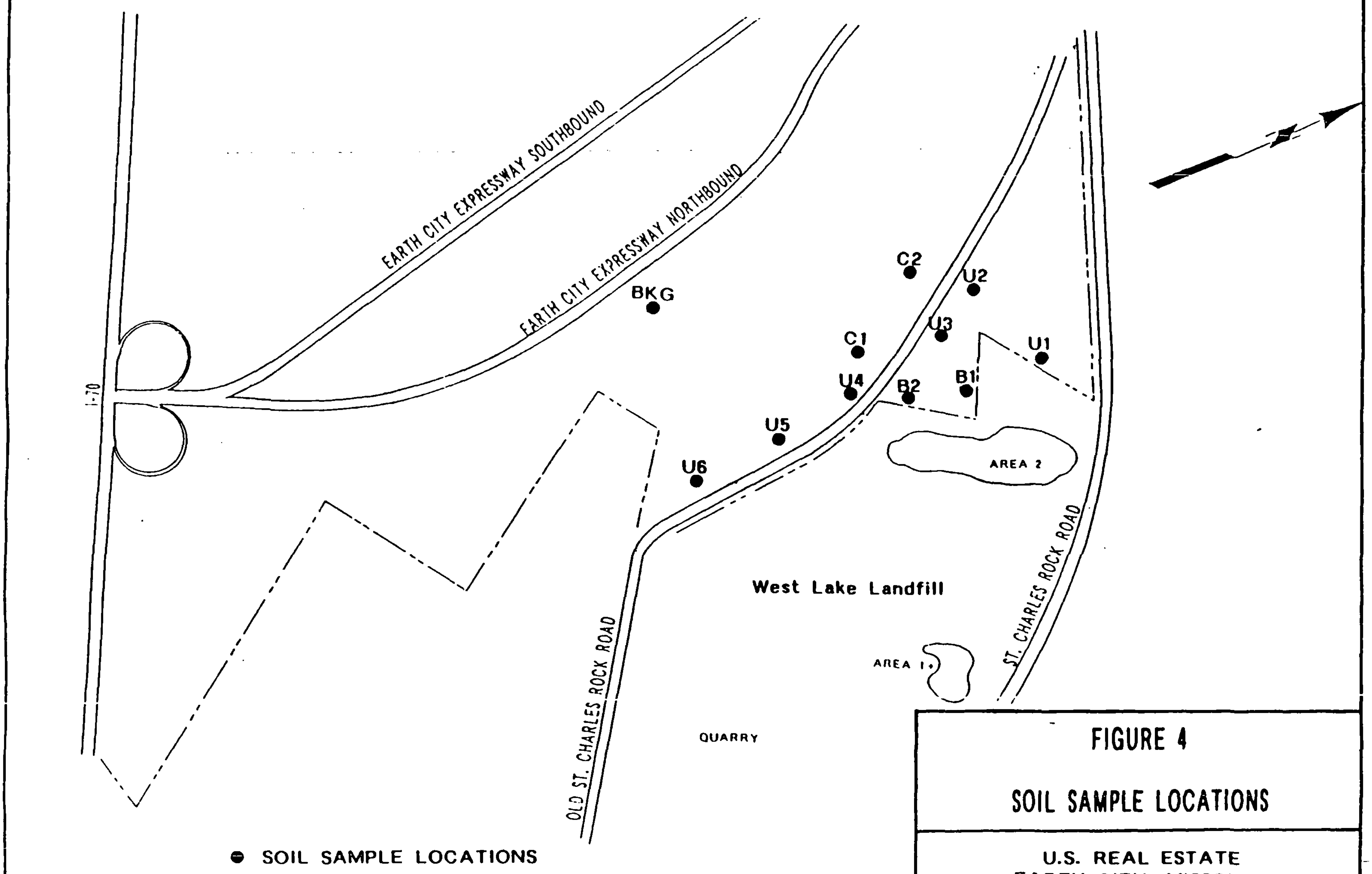

FIGURE 4

SOIL SAMPLE LOCATIONS

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

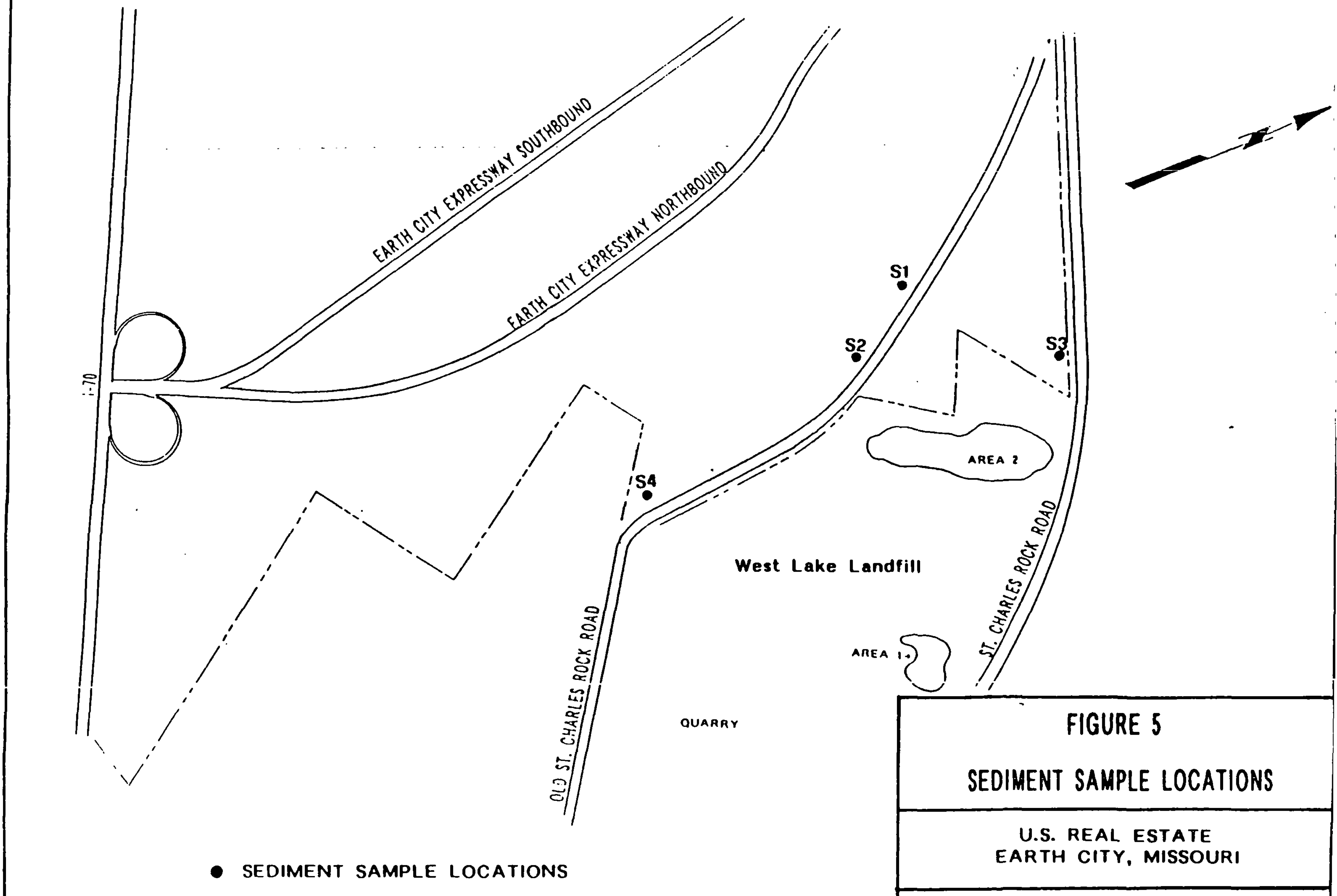

FIGURE 5

SEDIMENT SAMPLE LOCATIONS

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

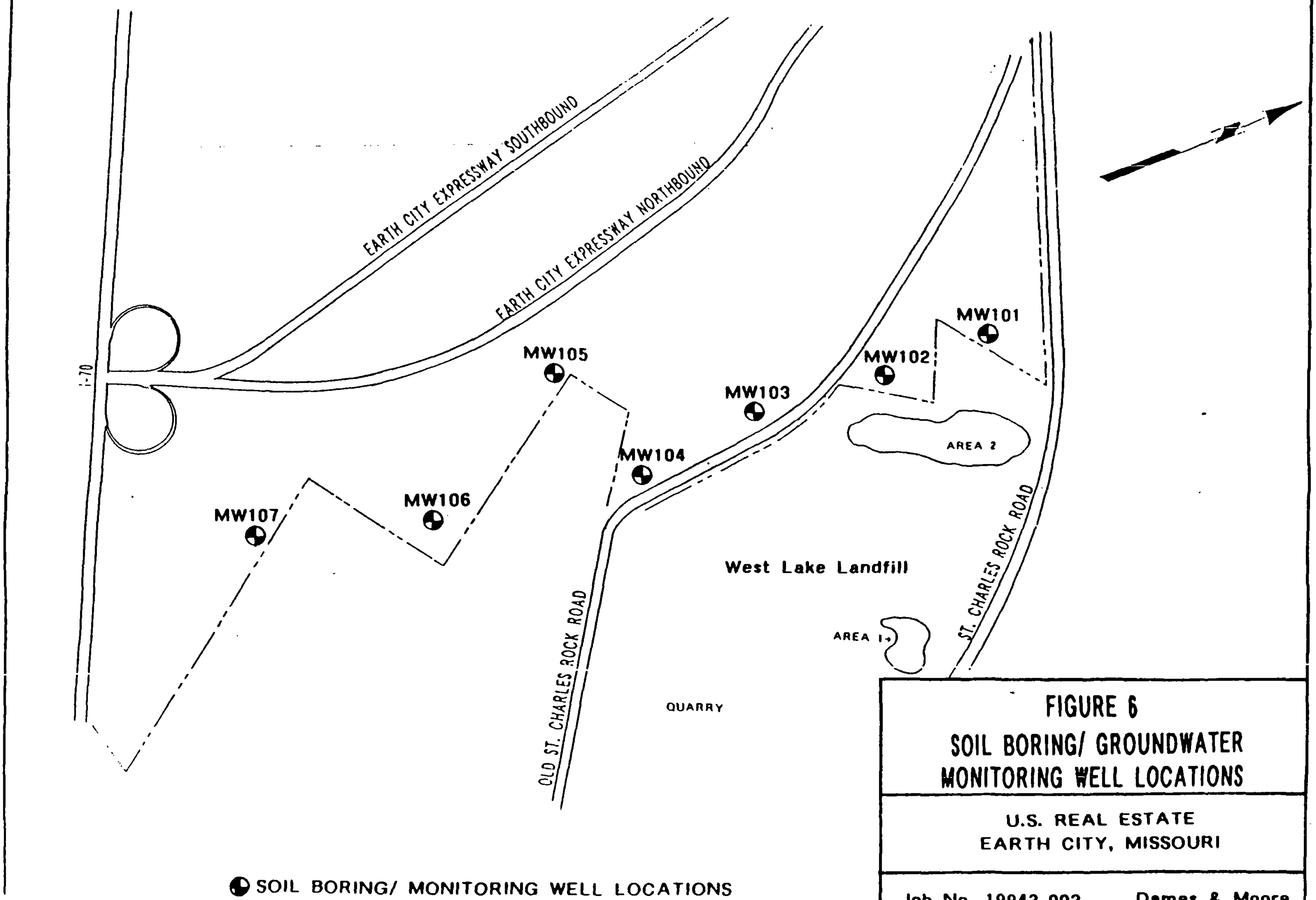

FIGURE 6
SOIL BORING/ GROUNDWATER MONITORING WELL LOCATIONS

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moore

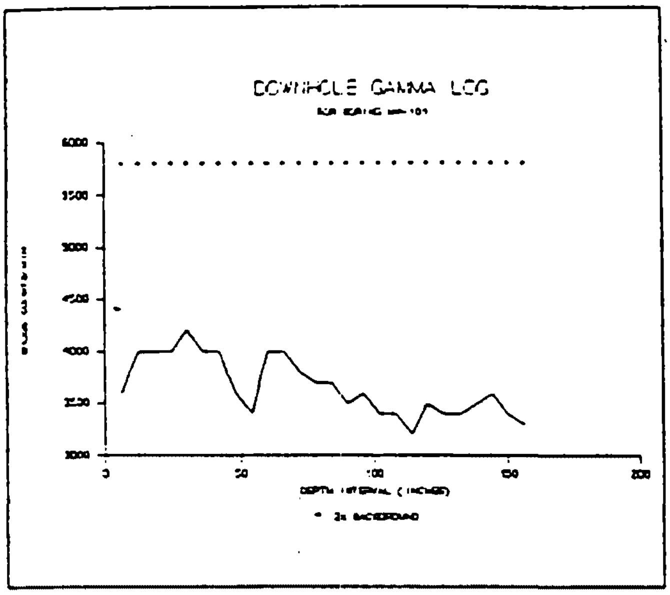

FIGURE 7-101

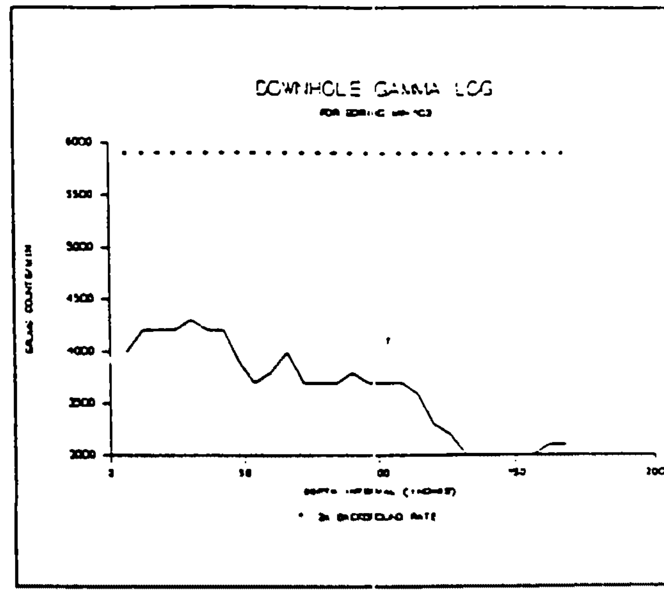

FIGURE 7-102

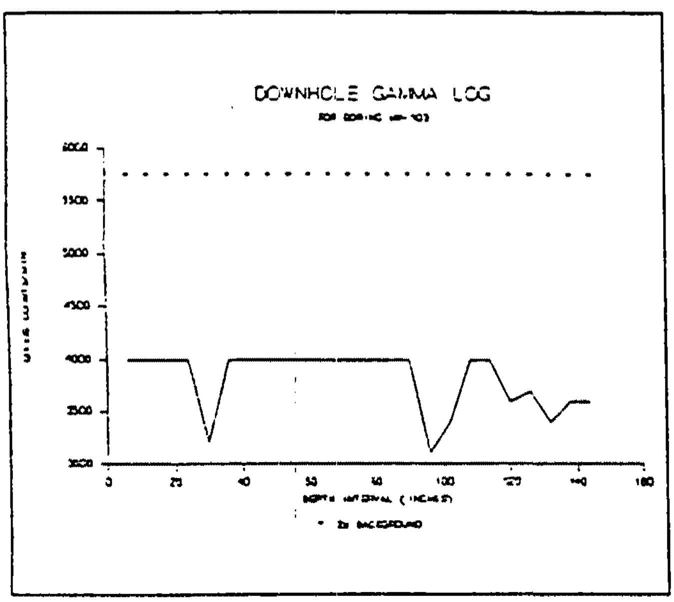

FIGURE 7-103

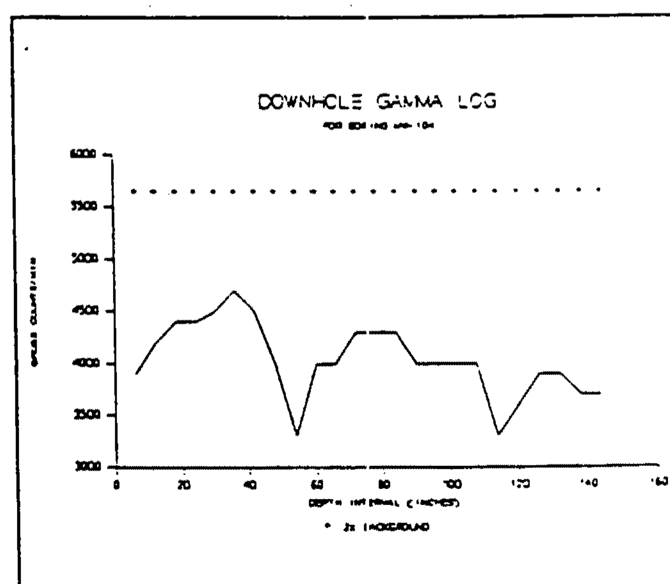

FIGURE 7-104

FIGURE 7

DOWNHOLE GAMMA RADIATION PLOTS

U.S. REAL ESTATE
EARTH CITY, MISSOURI

Job No. 19943-002 Dames & Moor

APPENDIX A
Certificates of Calibration

ICRON CORPORATION

12345 KINSMAN ROAD, NEWBURY, OHIO 44065
(216) 564-2251 telex 980474

CERTIFICATE OF INSTRUMENT CALIBRATION

CUSTOMER: DAMES & MOORE Q# 40040

INSTRUMENT MODEL: micro rem SERIAL # A880N

CALIBRATION DATA

RANGE	EXPOSURE RATE	INST. READING	EXPOSURE RATE	INST. READING
X1000	160 mR/h	160	40 mR/h	40
X100	16 mR/h	16	4 mR/h	4
X10	1.6 mR/h	1.6	400 uR/h	400
X1	160 uR/h	160	40 uR/h	40
X0.1	16 uR/h	16		

THE Cs-137 1 Ci SOURCE USED FOR THIS CALIBRATION HAS A CERTIFICATE STATING ITS TRACEABILITY TO N.B.S. (N.I.S.T.) STANDARDS.

* INSTRUMENT CALIBRATED WITH A CS-137 GAMMA SOURCE USING A CONVERSION FACTOR OF $\frac{1 \text{ urem/h}}{1 \text{ uR/h}}$

OTHER CALIBRATIONS AVAILABLE UPON REQUEST.

CALIBRATED BY: Thomas C. Reenan DATE: 1-18-90

MICRON CORPORATION

12345 KINSMAN ROAD, NEWBURY, OHIO 44065
(216) 564-2251 telex 980474

CERTIFICATE OF INSTRUMENT CALIBRATION

CUSTOMER: DAMES & MOORE Q# 40040

INSTRUMENT MODEL: micro rem SERIAL # A882N

CALIBRATION DATA

RANGE	EXPOSURE RATE	INST. READING	EXPOSURE RATE	INST. READING
X1000	160 mR/h	160	40 mR/h	40
X100	16 mR/h	16	4 mR/h	3.9
X10	1.6 mR/h	1.6	400 uR/h	400
X1	160 uR/h	160	40 uR/h	40
X0.1	16 uR/h	16		

THE Cs-137 1 Ci SOURCE USED FOR THIS CALIBRATION HAS A CERTIFICATE STATING ITS TRACEABILITY TO N.B.S. (N.I.S.T.) STANDARDS.

* INSTRUMENT CALIBRATED WITH A CS-137 GAMMA SOURCE USING A CONVERSION FACTOR OF $\frac{1\ urem/h}{1\ uR/h}$

OTHER CALIBRATIONS AVAILABLE UPON REQUEST.

CALIBRATED BY: Thomas C Leeman DATE: 1-18-90

APPENDIX B
Chain-of-Custody Records

1 of 2 DAVID PUR 1GTON

314-993-4599

ITC

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client FORD US REAL ESTATE

Field Personnel (Signature)

Project Title GARTH CITY

Job No. 19943-007

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4/02		S1	Sediment	1		0-6"
		S2	sed	1		0-6
		S3	sed	1	St. Chas Rock Rd	0-6
		S4	sed	1	SW End	0-6"
		C1	soil-comp	1		0-6
		C2	Soil comp	1		0-6
		UB-1	soil	1	ON/18W	
		UB-2	soil	1	N7 W37	
		UB-3	soil	1		
		UB-4	soil	1	12W/250S	
		UB-5	soil	1	440N/36W	
		UB-6	soil	1	170N/36W	

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Dd RPh	4/12	5:00									
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

2 of 2 PURINGT J, DAVID
314-993-4599

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: FORD US Real Estate

Field Personnel (Signature):

Project Title: Earth City

Job No. 15943-002

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4/12		B1-A	soil	1	Area 1	0-6
		B1-B	soil	1		0-6
		B1-C	soil	1		6-12
		B2-A	soil	1	Area 2	0-6
		B2-B	soil	1		0-6
		B2-C	soil	1		6-12
		BKG	soil	1		6-12
		WAT	water	1		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	4/12	5:00									
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

1 of 1 Dave Puringto
314-993-4599

21

Southwest

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client FORD US Real Estate

Project Title Earth City

Job No. 19943-002

Field Personnel (Signature)

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4/12		BKG	soil	3		TPH, Semi V, Pest, Herb, Met, CN
		S4	sediment	3		
		S3	sediment	3		
		Comp 2	soil	3		
		Comp 1	soil	3		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Dal P C	4/12	5:00									

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

1 of 1

Dave Purington
314-993-4599

CEP

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client FORD US Real Estate

Project Title Earth City - Phase II

Job No. 19943-002

Field Personnel (Signature)

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4/12		B1A	soil	1		0-6"
4/12		B2A	soil	1		0-6"

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	4/12	5:00									
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

7 of 7

David Purington

314-993-4599

ITC

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client

Field Personnel (Signature)

Project Title

Job No.

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	~~Sampling Site~~ Preservative	Remarks
4/10/90	12:15	MW 105U	Water	1	yes	Analyze for parameters
↓	12:15	MW 105F	↓	1	↓	discussed w/
↓	11:00	MW 106U	↓	1	↓	David Dooley
↓	11:00	MW 106F	↓	1	↓	Dames & Moore
↓	9:00	MW 107U	↓	1	↓	Buffalo, NY
↓	9:00	MW 107F	↓	1	↓	

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
D A R Pd											
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

David Durington 314 793-4599

2 boxes

ITC Attn Bill Commons

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: Ford

Project Title: Earth City

Job No.:

Field Personnel (Signature):

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4-17	9:00	MW110U	Water	1		Radiological Analysis
	9:00	MW110F				per discussion w/
	10:00	MW102U				David Dooley,
	10:00	MW102F				D-M, Buffalo NY
	10:30	MW108U				
	10:30	MW108F				
	13:30	MW103U				
	13:30	MW103F				
	14:30	MW104U				
	14:30	MW104F				
		MW101F				
		MW101U				

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	4/17	5:00									
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

1 of 2

David Rovington (proposal 2095)

Southwest

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: Ford Earth City

Project Title: 19943-002

Job No.:

Field Personnel (Signature):

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	~~Sampling Site~~ Preservative	Remarks
4-6-2	2:30	MW101	water	2 - 40ml	HCl	VOA
				1 - 2l	none	semivolatiles
				2 - 1l	none	herb/pest
				1 - 500ml	NaOH	~~metal~~ CN
				1 - 250ml	HNO3	metals
	12:15	MW105		2 - 40ml	HCl	VOA
				1 - 2l	none	semivolatiles
				2 - 1l	none	herb/pest
				1 - 500ml	NaOH	CN
				1 - 250ml	HNO3	metals

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
DMRPh	4/6	5:30									
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

2 of 2

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client						Field Personnel (Signature)
Project Title					Job No.	
Date	**Time**	**Sample I.D. No.**	**Sample Type**	**No. of Containers**	**Sampling Site**	**Remarks**
4-16-92	11:00	MW106	water	2 - 40ml	HCl	VOA
				1 - 2l	none	semivolatiles
				2 - 1l	none	herb/pest
				1 - 500ml	NaOH	CN
				1 - 250ml	HNO_3	metals
	9:00	MW 107		2 - 40ml	HCl	VOA
	9:00			1 - 2l	none	semivolatiles
				2 - 1l	none	herb/pest
				1 500ml	NaOH	CN
				1 250ml	HNO_3	Metals
	—	TR-1		1 - 40ml	HCl	VOA

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**	**Relinquished by: (Signature)**	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**
Relinquished by: (Signature)	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**	**Relinquished by: (Signature)**	**Date**	**Time**	**Received by: (Signature)**	**Date**	**Time**

[redacted] David Purington [redacted] : Southwest Lab [redacted] A [redacted] Fandy [redacted] 5/J9 [redacted]

314-993-4599

2 boxes

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: Ford

Project Title:

Job No. 19943-002

Field Personnel (Signature):

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4-12	9:00	MW110	water	7		VOC, Semi, pest, herb, metal
	10:00	MW102		7		
	10:30	MW108		7		
	13:30	MW103		7		
	14:30	MW104		7		
		TR-2		2		VOC

CW

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	4/17	5:00									

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

[redacted] Attn. Allan Field [redacted]

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client						Field Personnel (Signature)
Project Title					Job No. 19943-002	
Date	**Time**	**Sample I.D. No.**	**Sample Type**	**No. of Containers**	**Sampling Site**	**Remarks**
4-17	11:00	MW109	water	7		VOC, Semivol. Lbs
						Pest
						Herb
						metals
						CN

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[signature]	4/17	5:20	[signature] (EEI)	4/17	1720						

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Attn Jim Moeller
to CEP

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client Ford

Field Personnel (Signature)

Project Title Earth City

Job No. 19943-002

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4-17	1100	MW109U	water	1		For Radiological
4-17	11:00	MW109F	water	1		Analysis

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
DA RPL	4/17	5:00									

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

APPENDIX C
Laboratory Analytical Data

Controls for Environmental Pollution, Inc.
OUT OF STATE '0/546-2188 • FAX - 508-982-9289

Dames & Moore
11701 Borman Drive, Suite 340
Saint Louis, MO 63146

Date Received: 04/18/90
Date Reported: 05/09/90
Work Order: 90-04-353
Category:

Attn: Dave Purington

Work ID: Environmental
P O # :

DAMES & MOORE
MAY 14 1990
ST. LOUIS, MISSOURI

Test	Units	MW109U 04/17/90 11:00	MW109F 04/17/90 11:00
Gross Alpha	pCi/liter	<2	<2
Gross Beta	pCi/liter	7+/-3	<3
Cesium-137	pCi/liter	11.0 0.8	<2
Potassium-40	pCi/liter	<5	<5
Radium-226	pCi/liter	1.5+/-1.0	<0.6
Radium-228	pCi/liter	<1	<1
Thorium-228	pCi/liter	<0.6	<0.6
Thorium-230	pCi/liter	<0.6	<0.6

Controls for Environmental Pollution, Inc.
P.O. BOX 5351 • Santa Fe, New Mexico 87502 OUT OF STATE [illegible]0/545-2188 • FAX - 505-982-9289

 CEP, Inc. REPORT Work Order # 90-04-353

Received: 04/18/90 05/09/90 16:18:30 Continued From Above

Test	Units	MW109U	MW109F
		04/17/90 11:00	04/17/90 11:00
Thorium-232	pCi/liter	<0.6	<0.6
Uranium-234	pCi/liter	<0.6	<0.6
Uranium-235	pCi/liter	<0.6	<0.6
Uranium-238	pCi/liter	<0.6	<0.6

Certified By: ____________

REPORT TO: DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN: DAVID PURINGTON

PREPARED BY: IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831
ATTEN: ERS
PHONE: 615-482-9707

CERTIFIED BY

CONTACT: JIM DILLARD

CLIENT: DAMES ST SAMPLES: 1
COMPANY: DAMES & MOORE
FACILITY: ST. LOUIS, MO

AMENDED TO CORRECT UNITS AND RESULTS. U-ISO AND TH-230 AND TH-232 WERE ALSO ADDED TO COMPLETE REPORT.

WORK ID: WATER SAMPLE
TAKEN:
TRANS:
TYPE:
P.O. #:
INVOICE: under separate cover

SAMPLE IDENTIFICATION
01 WAT

TEST CODES and NAMES used on this report

GALPHA	GROSS ALPHA
GBETA	GROSS BETA
GS	GAMMA SPEC
RA226	RA-226
RA228	RA-228
TH228	TH-228
TH230	TH-230
TH232	TH-232
U234	U-234
U235	U-235/236
U238	U-238

Received: 04/13/90

ITRSL Oak Ridge REPORT
Results by Sample

Work Order # S0-04-049

SAMPLE ID WAT FRACTION 01A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/l
WRTN 05/18/90

VERIFIED BY KDF

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.84E+2		GROSS ALPHA	2.27E+1	0.36E+1
CS-137	<2.0E+1		GROSS BETA	4.92E+0	2.17E+0
			RA-226	2.16E+0	0.63E+0
			RA-228	<6.88E+0	
			U-234	1.02E+1	0.20E+1
			U-235/236	<1.0E+0	
			U-238	8.65E+0	1.80E+0
			TH-230	6.01E+1	0.87E+1
			TH-232	<1.0E+0	

Received: 04/13/90

ITRSL Oak Ridge REPORT 05/18/90 19:17:24

Work Order # 50-04-047

REPORT TO: DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN DAVID PURINGTON

PREPARED BY: IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831
ATTEN ERS
PHONE 615-482-9707

CERTIFIED BY

CONTACT JIM DILLARD

CLIENT DAMES ST SAMPLES 1
COMPANY DAMES & MOORE
FACILITY ST. LOUIS, MO

AMENDED TO CORRECT UNITS AND RESULTS. U-ISO AND TH-230 AND TH-232 WERE ALSO ADDED TO COMPLETE REPORT.

WORK ID WATER SAMPLE
TAKEN
TRANS
TYPE
P.O. #
INVOICE under separate cover

SAMPLE IDENTIFICATION
01 WAT

TEST CODES and NAMES used on this report

GALPHA	GROSS ALPHA
GBETA	GROSS BETA
GS	GAMMA SPEC
RA226	RA-226
RA228	RA-228
TH228	TH-228
TH230	TH-230
TH232	TH-232
U234	U-234
U235	U-235/236
U238	U-238

Received: 04/13/90

ITRSL Oak Ridge REPORT
Results by Sample

Work Order # SO-04-049

SAMPLE ID WAT FRACTION 01A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/l
WRTN 05/18/90

VERIFIED BY KDF

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.84E+2		GROSS ALPHA	2.27E+1	0.36E+1
CS-137	<2.0E+1		GROSS BETA	4.92E+0	2.17E+0
			RA-226	2.16E+0	0.63E+0
			RA-228	<6.88E+0	
			U-234	1.02E+1	0.20E+1
			U-235/236	<1.0E+0	
			U-238	8.65E+0	1.80E+0
			TH-230	6.01E+1	0.87E+1
			TH-232	<1.0E+0	

Received: 04/18/90

ITRSL Oak Ridge REPORT
05/18/90 15:27:40

Work Order # S0-04-065

REPORT TO: DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN: DAVID PURINGTON

PREPARED BY: IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831
ATTEN: ERS
PHONE: 615-482-9707

CERTIFIED BY

CONTACT: JIM DILLARD

CLIENT: DAMES ST
SAMPLES: 12
COMPANY: DAMES & MOORE
FACILITY: ST. LOUIS, MO

AMENDED TO INCLUDE U-ISO, TH-230 AND TH-232 FOR ALL FRACTIONS.

WORK ID: WATER SAMPLES
TAKEN:
TRANS:
TYPE:
P.O. #:
INVOICE: under separate cover

SAMPLE IDENTIFICATION		TEST CODES and NAMES used on this report	
01	MW110U	GALPHA	GROSS ALPHA
02	MW110F	GBETA	GROSS BETA
03	MW102U	GS	GAMMA SPEC
04	MW102F	RA226	RA-226
05	MW108U	RA228	RA-228
06	MW108F	TH228	TH-228
07	MW103U	TH230	TH-230
08	MW103F	TH232	TH-232
09	MW104U	U234	U-234
10	MW104F	U235	U-235/236
11	MW101F	U238	U-238
12	MW101U		

Received: 04/18/90

ITRSL Oak Ridge REPORT
Results by Sample

Work Order # S0-04-065

SAMPLE ID MW110U FRACTION 01A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/1
WRTN 05/18/90

VERIFIED BY RDJ

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.0E+2		GROSS ALHPA	<1.0E+0	
CS-137	<2.0E+1		GROSS BETA	<4.0E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	<1.0E+0	
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW110F FRACTION 02A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/1
WRTN 05/18/90

VERIFIED BY RDJ

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.9E+2		GROSS ALPHA	<1.0E+0	
CS-137	<2.0E+1		GROSS BETA	<4.0E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	<1.0E+0	
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW102U FRACTION 03A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.4E+2		GROSS ALPHA	<8.08E+0	
CS-137	<2.0E+1		GROSS BETA	7.09E+0	5.46E+0
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.42E+0	0.39E+0
			U-235/236	<1.0E+0	
			U-238	1.30E+0	0.38E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW102F FRACTION 04A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.8E+2		GROSS ALPHA	<2.26E+0	
CS-137	<2.0E+1		GROSS BETA	<8.43E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	2.43E+0	0.57E+0
			U-235/236	<1.0E+0	
			U-238	1.57E+0	0.45E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW108U FRACTION 05A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.9E+2		GROSS ALPHA	<7.50E+0	
CS-137	<2.0E+1		GROSS BETA	<1.03E+1	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	2.20E+0	0.47E+0
			U-235/236	<1.0E+0	
			U-238	1.67E+0	0.40E+0
			TH-230	1.57E+0	0.61E+0
			TH-232	<1.0E+0	

SAMPLE ID MW108F FRACTION 06A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.5E+2		GROSS ALPHA	<1.06E+1	
CS-137	<2.0E+1		GROSS BETA	<8.36E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	3.57E+0	0.62E+0
			U-235/236	<1.0E+0	
			U-238	2.93E+0	0.54E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW103U FRACTION 07A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/1 VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.5E+2		GROSS ALPHA	1.72E+1	0.96E+1
CS-137	<2.0E+1		GROSS BETA	2.34E+1	1.01E+1
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.26E+1	0.19E+1
			U-235/236	<1.0E+0	
			U-238	1.23E+1	0.19E+1
			TH-230	1.22E+0	0.52E+0
			TH-232	<1.0E+0	

SAMPLE ID MW103F FRACTION 08A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/1 VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.8E+2		GROSS ALPHA	<7.00E+0	
CS-137	<2.0E+1		GROSS BETA	<1.34E+1	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	5.10E+0	0.85E+0
			U-235/236	<1.0E+0	
			U-238	3.55E+0	0.66E+0
			TH-230	1.57E+0	0.45E+0
			TH-232	<1.0E+0	

SAMPLE ID MW104U FRACTION 09A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.4E+2		GROSS ALPHA	1.14E+1	0.74E+1
CS-137	<2.0E+1		GROSS BETA	1.87E+1	0.74E+1
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	3.80E+0	0.73E+0
			U-235/236	<1.0E+0	
			U-238	2.68E+0	0.59E+0
			TH-230	2.00E+0	0.65E+0
			TH-232	1.47E+0	0.55E+0

SAMPLE ID MW104F FRACTION 10A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.04E+2	0.60E+2	GROSS ALPHA	<2.0E+0	
CS-137	<2.0E+1		GROSS BETA	<8.3E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.98E+0	0.48E+0
			U-235/236	<1.0E+0	
			U-238	1.10E+0	0.35E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW101F FRACTION 11A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.6E+2		GROSS ALPHA	<7.7E+0	
CS-137	<2.0E+1		GROSS BETA	9.52E+0	6.27E+0
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.26E+0	0.31E+0
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW101U FRACTION 12A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/17/90 Category NA

UNITS pCi/l VERIFIED BY RDJ
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.3E+2		GROSS ALPHA	<1.0E+1	
CS-137	<2.0E+1		GROSS BETA	2.41E+1	0.84E+1
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	9.06E+0	1.75E+0
			U-235/236	1.37E+0	0.58E+0
			U-238	8.64E+0	1.69E+0
			TH-230	1.02E+0	0.36E+0
			TH-232	<1.0E+0	

Received: 04/17/90

ITRSL Oak Ridge REPORT 05/18/90 16:11:46

Work Order # 50-04-064

REPORT TO: DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN: DAVID PURINGTON

PREPARED BY: IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831
ATTEN: ERS
PHONE: 615-482-9707

CERTIFIED BY

CONTACT: JIM DILLARD

CLIENT: DAMES ST SAMPLES: 6
COMPANY: DAMES & MOORE
FACILITY: ST. LOUIS, MO

AMENDED TO INCLUDE U-ISO, TH-230 AND TH-232 ON ALL FRACTIONS AND TO CORRECT GROSS ALPHA AND GROSS BETA RESULTS FOR 05A.

WORK ID: WATER SAMPLES
TAKEN:
TRANS:
TYPE:
P.O. #:
INVOICE: under separate cover

SAMPLE IDENTIFICATION

01	MW105U
02	MW105F
03	MW106U
04	MW106F
05	MW107U
06	MW107F

TEST CODES and NAMES used on this report

GALPHA	GROSS ALPHA
GBETA	GROSS BETA
GS	GAMMA SPEC
RA226	RA-226
RA228	RA-228
TH228	TH-228
TH230	TH-230
TH232	TH-232
U234	U-234
U235	U-235/236
U238	U-238

SAMPLE ID MW105U FRACTION 01A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/l VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.45E+2	0.74E+2	GROSS ALPHA	1.69E+1	0.83E+1
CS-137	<2.0E+1		GROSS BETA	1.45E+1	0.91E+1
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	<1.0E+0	
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW105F FRACTION 02A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/L VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.4E+2		GROSS ALPHA	<1.01E+1	
CS-137	<2.0E+1		GROSS BETA	7.32E+0	5.64E+0
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.33E+0	0.33E+0
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW106U FRACTION 03A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/l VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	2.83E+2	1.14E+2	GROSS ALPHA	1.01E+2	0.23E+2
CS-137	<2.0E+1		GROSS BETA	2.95E+1	1.22E+1
			RA-226	1.41E+0	0.29E+0
			RA-228	<3.0E+0	
			U-234	2.18E+0	0.49E+0
			U-235/236	<1.0E+0	
			U-238	1.37E+0	0.38E+0
			TH-230	4.45E+0	1.16E+0
			TH-232	6.12E+0	1.45E+0

SAMPLE ID MW106F FRACTION 04A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/l VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.4E+2		GROSS ALPHA	<1.02E+1	
CS-137	<2.0E+1		GROSS BETA	<1.60E+1	
			RA-226	1.05E+0	0.25E+0
			RA-228	<3.0E+0	
			U-234	3.81E+0	0.63E+0
			U-235/236	<1.0E+0	
			U-238	2.65E+0	0.49E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW107U FRACTION 05A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/l VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.8E+2		GROSS ALPHA	2.35E+1	1.14E+1
CS-137	<2.0E+1		GROSS BETA	1.77E+1	1.10E+1
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	<1.0E+0	
			U-235/236	<1.0E+0	
			U-238	<1.0E+0	
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

SAMPLE ID MW107F FRACTION 06A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/16/90 Category NA

UNITS pCi/l VERIFIED BY KDF
WRTN 05/18/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	<1.8E+2		GROSS ALPHA	<1.01E+1	
CS-137	<2.0E+1		GROSS BETA	<9.26E+0	
			RA-226	<1.0E+0	
			RA-228	<3.0E+0	
			U-234	1.59E+0	0.39E+0
			U-235/236	<1.0E+0	
			U-238	1.24E+0	0.34E+0
			TH-230	<1.0E+0	
			TH-232	<1.0E+0	

Page 1
Received: 04/13/90

ITORL OAK RIDGE REPORT
05/31/90 15:57:35

Work Order # 50-05-179
Work Not Complete

REPORT TO DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN DAVID PURINGTON

PREPARED BY IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831

CERTIFIED BY

ATTEN ERS
PHONE 615-482-9707

CONTACT JIM DILLARD

CLIENT DAMES ST SAMPLES 3
COMPANY DAMES & MOORE
FACILITY ST. LOUIS, MO

* SAMPLES B1-A AND B2-A WILL BE REPORTED AT A LATER DATE.

WORK ID SOIL SAMPLES
TAKEN
TRANS
TYPE
P.O. #
INVOICE under separate cover

SAMPLE IDENTIFICATION

01	B2-A
02	S4
03	B1-A

TEST CODES and NAMES used on this report

GALPHA	GROSS ALPHA
GBETA	GROSS BETA
RA226	RA-226
RA228	RA-228
SPEC	SPECIAL FORM FOR REPORTING
TH228	TH-228
TH230	TH-230
TH232	TH-232

DAMES & MOORE
JUN 04 1990
ST. LOUIS, MISSOURI

Received: 04/13/90

ITORL OAK RIDGE REPORT
Results by Sample

Work Order # SO-05-179

SAMPLE ID B2-A

FRACTION 01A TEST CODE SPEC NAME SPECIAL FORM FOR REPORTING
Date & Time Collected 04/12/90 Category NA

PARAMETER	RESULT	2-SIGMA ERROR	UNITS
GROSS ALPHA	4.10E+3	0.83E+3	pCi/g
GROSS BETA	6.27E+2	1.29E+2	pCi/g
RA-226	8.95E+1	0.47E+1	pCi/g
RA-228	<1.16E+0		pCi/g
TH-ISO	*		

SAMPLE ID S4

FRACTION 02A TEST CODE SPEC NAME SPECIAL FORM FOR REPORTING
Date & Time Collected 04/12/90 Category NA

PARAMETER	RESULT	2-SIGMA ERROR	UNITS
GROSS ALPHA	1.93E+1	0.86E+1	pCi/g

Received: 04/13/90

ITORL OAK RIDGE REPORT
Results by Sample

Work Order # S0-05-179

SAMPLE ID B1-A

FRACTION 03A TEST CODE SPEC NAME SPECIAL FORM FOR REPORTING
Date & Time Collected 04/12/90 Category NA

PARAMETER	RESULT	2-SIGMA ERROR	UNITS
GROSS ALPHA	1.14E+3	0.24E+3	pCi/g
GROSS BETA	2.50E+2	0.53E+2	pCi/g
TH-ISO	*		

REPORT TO DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN DAVID PURINGTON

PREPARED BY IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831

CERTIFIED BY

ATTEN ERS
PHONE 615-482-9707

CONTACT JIM DILLARD

CLIENT DAMES ST SAMPLES 1
COMPANY DAMES & MOORE
FACILITY ST. LOUIS, MO

WORK ID WATER SAMPLE
TAKEN
TRANS
TYPE
P.O. #
INVOICE under separate cover

SAMPLE IDENTIFICATION
01 MW 106U

TEST CODES and NAMES used on this report
GALPHA GROSS ALPHA
SPEC SPECIAL FORM FOR REPORTING

ITORL OAK RIDGE REPORT
Results by Sample

Work Order # S0-05-180

SAMPLE ID MW 106U

FRACTION 01A TEST CODE SPEC NAME SPECIAL FORM FOR REPORTING
Date & Time Collected 04/16/90 Category NA

PARAMETER	RESULT	2-SIGMA ERROR	UNITS
GROSS ALPHA	3.07E+2	1.33E+2	pCi/l

TCT - St. Louis
formerly Envirodyne Engineers, Inc.
Consulting Engineers, Scientists and Analytical Services
1908 Innerbelt Business Center Drive
St. Louis, Missouri 63114-5700
(314) 426-0880
Fax (314) 426-4212

REPORT OF ANALYSIS

CLIENT: Mr. Dave Purington
Dames & Moore
11960 Westline Ind. Drive
Suite 155
St. Louis, MO 63146

REPORT DATE: May 10, 1990
SAMPLE ANALYZED: One water sample analyzed for the parameters listed below.

DATE RECEIVED: April 18, 1990

PROJ. #: 3500-00385
P.O. #:

PARAMETER	UNITS	MW109	MW109 DUPLICATE
ANTIMONY	(UG/L)	< 24	< 24
ARSENIC	(UG/L)	3.1	2.5
BERYLLIUM	(UG/L)	< 3	< 3
CADMIUM	(UG/L)	< 3	< 3
CHROMIUM	(UG/L)	< 10	< 10
COPPER	(UG/L)	< 14	< 14
LEAD	(UG/L)	< 73	< 73
MERCURY	(UG/L)	0.48	-
NICKEL	(UG/L)	< 15	< 15
SILVER	(UG/L)	1.1	<1.0
SELENIUM	(UG/L)	1.3	<1.0
THALLIUM	(UG/L)	<1.0	<1.0
ZINC	(UG/L)	< 16	< 16

PARAMETER	UNITS	MW109
CYANIDE	(UG/L)	< 5

NOTE: See reverse side for "STANDARD CLAUSES."

APPROVED: Lisa A. Leehy
Lisa A. Leehy, Program Coordinator

disk 87/bbg

DAMES & MOORE
MAY 14 1990
ST. LOUIS, MISSOURI

REPORT OF ANALYSIS

CLIENT: Mr. Dave Purington
Dames & Moore

REPORT DATE: May 10, 1990
DATE RECEIVED: April 18, 1990

PROJ. #: 3500-00385

P.O. #:

PARAMETER	UNITS	DETECTION LIMITS	BLANK	MW109	MW109 DUPLICATE
LINDANE	(UG/L)	0.002	<0.002	<0.002	<0.002
HEPTACHLOR	(UG/L)	0.003	<0.003	<0.003	<0.003
HEPTACHLOR EPOXIDE	(UG/L)	0.004	<0.004	<0.004	<0.004
ENDOSULFAN I	(UG/L)	0.005	<0.005	<0.005	<0.005
DIELDRIN	(UG/L)	0.006	<0.006	<0.006	<0.006
ENDOSULFAN II	(UG/L)	0.010	<0.010	<0.010	<0.010
4,4'-DDT	(UG/L)	0.015	<0.015	<0.015	<0.015
ENDRIN ALDEHYDE	(UG/L)	0.024	<0.024	<0.024	<0.024
METHOXYCHLOR	(UG/L)	0.063	<0.063	<0.063	<0.063
alpha-BHC	(UG/L)	0.002	<0.002	<0.002	<0.002
beta-BHC	(UG/L)	0.005	<0.005	<0.005	<0.005
delta-BHC	(UG/L)	0.001	<0.001	<0.001	<0.001
gamma-CHLORDANE	(UG/L)	0.003	<0.003	<0.003	<0.003
alpha-CHLORDANE	(UG/L)	0.003	<0.003	<0.003	<0.003
4,4'-DDE	(UG/L)	0.006	<0.006	<0.006	<0.006
ENDRIN	(UG/L)	0.016	<0.016	<0.016	<0.016
4,4'-DDD	(UG/L)	0.011	<0.011	<0.011	<0.011
ENDOSULFAN SULFATE	(UG/L)	0.022	<0.022	<0.022	<0.022
ENDRIN KETONE	(UG/L)	0.019	<0.019	<0.019	<0.019
AROCLOR-1016	(UG/L)	0.047	<0.047	<0.047	<0.047
AROCLOR-1260	(UG/L)	0.187	<0.187	<0.187	<0.187
AROCLOR-1221	(UG/L)	0.107	<0.107	<0.107	<0.107
AROCLOR-1232	(UG/L)	0.083	<0.083	<0.083	<0.083
AROCLOR-1242	(UG/L)	0.044	<0.044	<0.044	<0.044
AROCLOR-1254	(UG/L)	0.054	<0.054	<0.054	<0.054
AROCLOR-1248	(UG/L)	0.094	<0.094	<0.094	<0.094
ALDRIN	(UG/L)	0.003	<0.003	<0.003	<0.003
TOXAPHENE	(UG/L)	0.205	<0.205	<0.205	<0.205

PARAMETER	UNITS	DETECTION LIMITS	BLANK	MW109	MW109 DUPLICATE
2,4-D	(UG/L)	0.745	<0.745	<0.745	<0.745
SILVEX	(UG/L)	0.197	<0.197	<0.197	<0.197

REPORT OF ANALYSIS

CLIENT: Mr. Dave Purington
Dames & Moore

REPORT DATE: May 10, 1990
DATE RECEIVED: April 18, 1990

PROJ. #: 3500-00385

P.O. #:

VOLATILE COMPOUNDS	DETECTION LIMIT (UG/L)	BLANK (UG/L)	MW109 (UG/L)
ACROLEIN	100	ND	ND
ACRYLONITRILE	100	ND	ND
BENZENE	5	ND	ND
BROMODICHLOROMETHANE	5	ND	ND
BROMOFORM	5	ND	ND
BROMOMETHANE	10	ND	ND
CARBON TETRACHLORIDE	5	ND	ND
CHLOROBENZENE	5	ND	ND
CHLOROETHANE	10	ND	ND
2-CHLOROETHYL VINYL ETHER	5	ND	ND
CHLOROFORM	5	ND	ND
CHLOROMETHANE	10	ND	ND
DIBROMOCHLOROMETHANE	5	ND	ND
1,1-DICHLORETHANE	5	ND	6
1,2-DICHLOROETHANE	5	ND	ND
1,1-DICHLOROETHENE	5	ND	ND
TOTAL 1,2-DICHLOROETHENE	5	ND	ND
1,2-DICHLOROPROPANE	5	ND	ND
CIS-1,3-DICHLOROPROPENE	5	ND	ND
ETHYL BENZENE	5	ND	ND
METHYLENE CHLORIDE	5	ND	ND
1,1,2,2-TETRACHLOROETHANE	5	ND	ND
TETRACHLOROETHYLENE	5	ND	ND
TOLUENE	5	ND	ND
1,1,1-TRICHLOROETHANE	5	ND	ND
1,1,2-TRICHLOROETHANE	5	ND	ND
TRICHLOROETHENE	5	ND	ND
VINYL CHLORIDE	10	ND	ND

SURROGATE COMPOUNDS	% RCVRY	% RCVRY
1,2-DICHLOROETHANE-D4	94	88
TOLUENE-D8	101	99
p-BFB	98	98

REPORT OF ANALYSIS

CLIENT: Mr. Dave Purington
Dames & Moore

REPORT DATE: May 10, 1990
DATE RECEIVED: April 18, 1990

PROJ. #: 3500-00385

P.O. #:

ACID COMPOUNDS	DETECTION LIMIT (UG/L)	BLANK (UG/L)	MW109 (UG/L)	MW109 DUP (UG/L)
2-CHLOROPHENOL	10	ND	ND	ND
2,4-DICHLOROPHENOL	10	ND	ND	ND
2,4-DIMETHYLPHENOL	10	ND	ND	ND
2,4-DINITROPHENOL	50	ND	ND	ND
2-NITROPHENOL	10	ND	ND	ND
4-NITROPHENOL	50	ND	ND	ND
PENTACHLOROPHENOL	50	ND	ND	ND
PHENOL	10	ND	ND	ND
2,4,6-TRICHLOROPHENOL	10	ND	ND	ND
2-METHYL-4,6-DINITROPHENOL	50	ND	ND	ND
4-CHLORO-3-METHYLPHENOL	10	ND	ND	ND

SURROGATE COMPOUNDS	% RCVRY	% RCVRY	% RCVRY
2-FLUOROPHENOL	48	4*	2*
PHENOL-d6	34	2*	1*
2,4,6-TRIBROMOPHENOL	68	7*	2*

*Below QC limits

BASE NEUTRAL COMPOUNDS	DETECTION LIMIT (UG/L)	BLANK (UG/L)	MW109 (UG/L)	MW109 DUP (UG/L)
ACENAPHTHENE	10	ND	ND	ND
ACENAPHTHYLENE	10	ND	ND	ND
ANTHRACENE	10	ND	ND	ND
BENZIDINE	50	ND	ND	ND
BENZ(A)ANTHRACENE	10	ND	ND	ND
BENZO(B,K)FLUORANTHENE	10	ND	ND	ND
BENZO(GHI)PERYLENE	10	ND	ND	ND
BENZO(A)PYRENE	10	ND	ND	ND
BIS(2-CHLOROETHOXY)METHANE	10	ND	ND	ND
BIS(2-CHLOROETHYL)ETHER	10	ND	ND	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	ND	ND
BIS(2-ETHYLHEXYL)PHTHALATE	10	< DL	ND	14

REPORT OF ANALYSIS

CLIENT: Mr. Dave Purington
Dames & Moore

REPORT DATE: May 10, 1990
DATE RECEIVED: April 18, 1990

PROJ. #: 3500-00385

P.O. #:

BASE NEUTRAL COMPOUNDS CONTD.	DETECTION LIMIT (UG/L)	BLANK (UG/L)	MW109 (UG/L)	MW109 DUP (UG/L)
4-BROMOPHENYL PHENYL ETHER	10	ND	ND	ND
BUTYL BENZYL PHTHALATE	10	ND	ND	ND
2-CHLORONAPHTHALENE	10	ND	ND	ND
4-CHLOROPHENYL PHENYL ETHER	10	ND	ND	ND
CHRYSENE	10	ND	ND	ND
DIBENZO(A,H)ANTHRACENE	10	ND	ND	ND
DI-N-BUTYL PHTHALATE	10	ND	ND	ND
1,2-DICHLOROBENZENE	10	ND	ND	ND
1,3-DICHLOROBENZENE	10	ND	ND	ND
1,4-DICHLOROBENZENE	10	ND	ND	ND
3,3'-DICHLOROBENZIDINE	20	ND	ND	ND
DIETHYL PHTHALATE	10	ND	ND	ND
DIMETHYL PHTHALATE	10	ND	ND	ND
2,4-DINITROTOLUENE	10	ND	ND	ND
2,6-DINITROTOLUENE	10	ND	ND	ND
DI-N-OCTYL PHTHALATE	10	ND	ND	ND
1,2-DIPHENYLHYDRAZINE	10	ND	ND	ND
DI-N-PROPYLNITROSAMINE	10	ND	ND	ND
FLUORANTHENE	10	ND	ND	ND
FLUORENE	10	ND	ND	ND
HEXACHLOROBENZENE	10	ND	ND	ND
HEXACHLOROBUTADIENE	10	ND	ND	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	ND	ND
HEXACHLOROETHANE	10	ND	ND	ND
INDENO(1,2,3-CD)PYRENE	10	ND	ND	ND
ISOPHORONE	10	ND	ND	ND
NAPHTHALENE	10	ND	ND	ND
NITROBENZENE	10	ND	ND	ND
N-NITROSODIMETHYLAMINE	10	ND	ND	ND
N-NITROSODIPHENYLAMINE	10	ND	ND	ND
PHENANTHRENE	10	ND	ND	ND
PYRENE	10	ND	ND	ND
1,2,4-TRICHLOROBENZENE	10	ND	ND	ND

SURROGATE COMPOUNDS	% RCVRY	% RCVRY	% RCVRY
NITROBENZENE-d5	79	57	81
2-FLUOROBIPHENYL	62	48	71
TERPHENYL-d14	79	63	84

P.O. BOX 5351 • Santa Fe, New Mexico 87502 OUT OF STATE 800/545-2188 • FAX

Dames & Moore
11701 Borman Drive, Suite 340
Saint Louis, MO 63146

Attn: Dave Purington

Work ID: Environmental
P O # : 19943-002

Date Received: 04/16/90
Date Reported: 05/16/90
Work Order: 90-04-263
Category:

Certified By: ____________

DAMES & MOORE
MAY 22 1990
ST. LOUIS, MISSOURI

P.O. BOX 5351 • Santa Fe, New Mexico 87502 OUT OF STATE 800/545-2188 • FAX - 505-982-9289

 CEP, Inc. REPORT Work Order # 90-04-263
Received: 04/16/90 Results by Sample

SAMPLE ID B1A FRACTION 01A TEST CODE AB S NAME Gross Alpha/Beta
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Gross Alpha	0.3	44.6+/-1.8
Gross Beta	0.1	21.2+/-0.6

All results reported in:

UNITS pCi/gram

SAMPLE ID B1A FRACTION 01A TEST CODE CS1375 NAME Cesium-137
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Cesium-137	0.1	0.14+/-0.06

All results reported in:

UNITS pCi/gram

P.O. Box 5351 • Santa Fe, New Mexico [illegible]

 CEP, Inc. REPORT Work Order # 90-04-263
Received: 04/16/90 Results by Sample

SAMPLE ID B1A FRACTION 01A TEST CODE ISOU S NAME Isotopic Uranium
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Uranium-234	0.05	4.2+/-0.5
Uranium-235	0.05	0.6+/-0.2
Uranium-238	0.05	1.6+/-0.3

All results report in:

UNITS pCi/gram

SAMPLE ID B1A FRACTION 01A TEST CODE K 40 S NAME Potassium-40
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	RESULT
Potassium-40	11.1+/-1.4

All results reported in:

UNITS pCi/gram

Page 4 CEP, Inc. REPORT Work Order # 90-04-263
Received: 04/16/90 Results by Sample

SAMPLE ID B1A FRACTION 01A TEST CODE R26285 NAME Radium-226/228
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Radium-226	0.6	41.4+/-0.4
Radium-228	0.1	<0.1

All results report in:

UNITS pCi/gram

SAMPLE ID B1A FRACTION 01A TEST CODE TH2305 NAME Thorium-230
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Thorium-230	0.05	<0.2

All results reported in:

UNITS pCi/gram

Controls for Environmental ...
P.O. BOX 5351 • Santa Fe, New Mexico ... OUT OF STATE 800/545-2188 • FAX - 505-982-9289

 CEP, Inc. REPORT Work Order # 90-04-263
Received: 04/16/90 Results by Sample

SAMPLE ID B1A FRACTION 01A TEST CODE TH2325 NAME Thorium-232
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Thorium-232	0.05	0.96+/-0.18

All results reported in:

UNITS pCi/gram

SAMPLE ID B2A FRACTION 02A TEST CODE AB S NAME Gross Alpha/Beta
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Gross Alpha	0.3	199.1+/-2.4
Gross Beta	0.1	34.5+/-0.5

All results reported in:

UNITS pCi/gram

Page 6 CEP, Inc. REPORT Work Order # 90-04-263
Received: 04/16/90 Results by Sample

SAMPLE ID B2A FRACTION 02A TEST CODE CS137S NAME Cesium-137
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Cesium-137	0.1	<0.1

All results reported in:

UNITS pCi/gram

SAMPLE ID B2A FRACTION 02A TEST CODE ISOU S NAME Isotopic Uranium
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Uranium-234	0.05	14.4+/-0.8
Uranium-235	0.05	0.2+/-0.1
Uranium-238	0.05	2.4+/-0.3

All results report in:

UNITS pCi/gram

P.O. BOX 5351 • Santa Fe, New Mexico [illegible] OUT OF STATE 800/545-[illegible] • FAX [illegible]

 CEP, Inc. REPORT Work Order # 90-04-263

Received: 04/16/90

Results by Sample

SAMPLE ID B2A FRACTION 02A TEST CODE K_40_5 NAME Potassium-40

Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	RESULT
Potassium-40	9.2+/-3.3

All results reported in:

UNITS pCi/gram

SAMPLE ID B2A FRACTION 02A TEST CODE R26289 NAME Radium-226/228

Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/g	RESULT
Radium-226	0.6	132+/-8
Radium-228	0.1	150+/-38

All results report in:

UNITS pCi/gram

P.O. BOX 5351 • Santa Fe, New Mexico 87502 OUT OF STATE 800/545-2188 • FAX - 505-982-9289

Received: 04/16/90 Results by Sample

SAMPLE ID B2A FRACTION 02A TEST CODE TH2305 NAME Thorium-230
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Thorium-230	0.05	<0.2

All results reported in:

UNITS pCi/gram

SAMPLE ID B2A FRACTION 02A TEST CODE TH2325 NAME Thorium-232
Date & Time Collected 04/12/90 Category SOIL

Type of Analysis	Detection Limit pCi/gram	RESULT
Thorium-232	0.05	1.3+/-0.5

All results reported in:

UNITS pCi/gram

Received: 04/13/90

ITRSL Oak Ridge REPORT 05/15/90 15:53:05

Work Order # S0-04-048

REPORT TO DAMES & MOORE
11701 BORMAN DRIVE
SUITE 340
ST. LOUIS, MO 63146
ATTEN DAVID PURINGTON

PREPARED BY IT/RADIOLOGICAL SCIENCES LAB.
1550 BEAR CREEK ROAD
OAK RIDGE, TN 37831
ATTEN ERS
PHONE 615-482-9707

CERTIFIED BY

CONTACT JIM DILLARD

CLIENT DAMES ST SAMPLES 19
COMPANY DAMES & MOORE
FACILITY ST. LOUIS, MO

WORK ID SOIL SAMPLES
TAKEN
TRANS
TYPE
P.O. #
INVOICE under separate cover

SAMPLE IDENTIFICATION

01	S1
02	S2
03	S3
04	S4
05	C1
06	C2
07	UB-1
08	UB-2
09	UB-3
10	UB-4
11	UB-5
12	UB-6
13	B1-A
14	B1-B
15	B1-C
16	B2-A
17	B2-B
18	B2-C
19	BKG

TEST CODES and NAMES used on this report

GALPHA	GROSS ALPHA
GBETA	GROSS BETA
GS	GAMMA SPEC
RA226	RA-226
RA228	RA-228
TH228	TH-228
TH230	TH-230
TH232	TH-232
U234	U-234
U235	U-235/236
U238	U-238

SAMPLE ID S1 FRACTION 01A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY ERS
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.77E+1	0.30E+1	GROSS ALPHA	3.21E+1	1.18E+1
CS-137	<2.0E-1		GROSS BETA	2.67E+1	1.10E+1
RA-226	1.18E+0	0.14E+0	U-234	1.01E+0	0.25E+0
RA-228	1.24E+0	0.26E+0	U-235/236	<6.0E-1	
			U-238	3.84E-1	2.30E-1
			TH-230	1.28E+0	0.32E+0
			TH-232	1.02E+0	0.27E+0

SAMPLE ID S2 FRACTION 02A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY ERS
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	5.12E+0	0.95E+0	GROSS ALPHA	1.74E+1	0.77E+1
RA-226	1.16E+0	0.12E+0	GROSS BETA	2.57E+1	0.91E+1
RA-228	1.29E+0	0.16E+0	U-234	9.51E-1	2.69E-1
CS-137	6.95E-2	3.24E-2	U-235/236	<6.0E-1	
			U-238	1.07E+0	0.29E+0
			TH-230	2.25E+0	0.40E+0
			TH-232	1.17E+0	0.35E+0

SAMPLE ID S3 FRACTION 03A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.02E+1	0.14E+1	GROSS ALPHA	2.32E+1	0.91E+1
CS-137	<2.0E-1		GROSS BETA	1.79E+1	0.76E+1
RA-226	7.83E-1	0.84E-1	U-234	7.48E-1	1.91E-1
RA-228	5.86E-1	1.02E-1	U-235/236	<6.0E-1	
			U-238	7.82E-1	1.96E-1
			TH-230	2.55E+0	0.44E+0
			TH-232	7.05E-1	1.81E-1

SAMPLE ID S4 FRACTION 04A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY ERS
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.09E+1	0.15E+1	GROSS ALPHA	2.19E+2	0.50E+2
CS-137	<0.2		GROSS BETA	2.73E+1	0.94E+1
RA-226	1.18E+0	0.11E+0	U-234	1.06E+0	0.28E+0
RA-228	1.26E+0	0.16E+0	U-235/236	<6.0E-1	
			U-238	6.38E-1	2.10E-1
			TH-230	2.38E+0	0.49E+0
			TH-232	1.08E+0	0.29E+0

SAMPLE ID C1 FRACTION 05A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.01E+1	0.14E+1	GROSS ALPHA	1.50E+1	0.71E+1
CS-137	<2.0E-1		GROSS BETA	2.55E+1	1.01E+1
RA-226	1.06E+0	0.11E+0	U-234	9.51E-1	2.80E-1
RA-228	1.22E+0	0.16E+0	U-235/236	<6.0E-1	
			U-238	9.51E-1	2.80E-1
			TH-230	2.22E+0	0.45E+0
			TH-232	1.32E+0	0.32E+0

SAMPLE ID C2 FRACTION 06A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.82E+1	0.29E+1	GROSS ALPHA	1.84E+1	0.82E+1
CS-137	<2.0E-1		GROSS BETA	2.18E+1	0.98E+1
RA-226	1.15E+0	0.12E+0	U-234	1.02E+0	0.24E+0
RA-228	1.29E+0	0.18E+0	U-235/236	<6.0E-1	
			U-238	7.65E-1	2.01E-1
			TH-230	2.37E+0	0.43E+0
			TH-232	1.22E+0	0.27E+0

SAMPLE ID UB-1 FRACTION 07A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	9.91E+0	1.36E+0	GROSS ALPHA	2.36E+1	0.99E+1
CS-137	2.97E-1	0.55E-1	GROSS BETA	2.35E+1	0.85E+1
RA-226	1.02E+0	0.10E+0	U-234	1.27E+0	0.25E+0
RA-228	1.11E+0	0.14E+0	U-235/236	<6.0E-1	
			U-238	1.04E+0	0.22E+0
			TH-230	2.53E+0	0.50E+0
			TH-232	9.85E-1	2.68E-1

SAMPLE ID UB-2 FRACTION 08A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.17E+1	0.16E+1	GROSS ALPHA	2.60E+1	1.01E+1
CS-137	3.05E-1	0.59E-1	GROSS BETA	3.00E+1	1.11E+1
RA-226	1.15E+0	0.11E+0	U-234	1.22E+0	0.25E+0
RA-228	1.22E+0	0.15E+0	U-235/236	<6.0E-1	
			U-238	1.22E+0	0.25E+0
			TH-230	1.83E+0	0.43E+0
			TH-232	1.16E+0	0.33E+0

 ITRSL Oak Ridge REPORT Work Order # S0-04-048
Results by Sample

SAMPLE ID UB-3 FRACTION 09A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.46E+1	0.19E+1	GROSS ALPHA	2.58E+1	1.01E+1
CS-137	2.43E-1	0.58E-1	GROSS BETA	3.11E+1	1.09E+1
RA-226	1.16E+0	0.11E+0	U-234	9.10E-1	1.98E-1
RA-228	1.22E+0	0.16E+0	U-235/236	<6.0E-1	
			U-238	9.24E-1	2.00E-1
			TH-230	2.23E+0	0.46E+0
			TH-232	1.18E+0	0.30E+0

SAMPLE ID UB-4 FRACTION 10A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.77E+1	0.29E+1	GROSS ALPHA	2.00E+1	0.85E+1
CS-137	<2.0E-1		GROSS BETA	2.90E+1	0.99E+1
RA-226	1.07E+0	0.12E+0	U-234	9.52E-1	2.11E-1
RA-228	1.35E+0	0.20E+0	U-235/236	<6.0E-1	
			U-238	7.38E-1	1.82E-1
			TH-230	2.11E+0	0.42E+0
			TH-232	1.07E+0	0.27E+0

SAMPLE ID UB-5 FRACTION 11A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.86E+1	0.30E+1	GROSS ALPHA	1.83E+1	0.83E+1
CS-137	<2.0E-1		GROSS BETA	2.56E+1	0.97E+1
RA-226	1.14E+0	0.13E+0	U-234	1.27E+0	0.26E+0
RA-228	1.55E+0	0.22E+0	U-235/236	<6.0E-1	
			U-238	9.71E-1	2.17E-1
			TH-230	3.06E+0	0.65E+0
			TH-232	1.64E+0	0.42E+0

SAMPLE ID UB-6 FRACTION 12A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.97E+1	0.32E+1	GROSS ALPHA	2.75E+1	0.99E+1
CS-137	2.13E-1	0.54E-1	GROSS BETA	2.51E+1	0.80E+1
RA-266	1.23E+0	0.14E+0	U-234	1.19E+0	0.27E+0
RA-228	1.52E+0	0.21E+0	U-235/236	<6.0E-1	
			U-238	1.16E+0	0.26E+0
			TH-230	2.52E+0	0.52E+0
			TH-232	1.23E+0	0.32E+0

SAMPLE ID B1-A FRACTION 13A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.24E+1	0.22E+1	GROSS ALPHA	1.65E+3	0.34E+3
CS-137	<2.0E-1		GROSS BETA	3.13E+2	0.66E+2
RA-226	3.95E+1	0.33E+1	U-234	7.91E+0	1.03E+0
RA-228	9.59E-1	3.40E-1	U-235/236	<6.0E-1	
			U-238	6.90E+0	0.92E+0
			TH-230	1.58E+3	0.37E+3
			TH-232	5.09E+0	1.59E+0

SAMPLE ID B1-B FRACTION 14A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	6.78E+0	1.45E+0	GROSS ALPHA	1.98E+3	0.40E+3
CS-137	<2.0E-1		GROSS BETA	3.04E+2	0.64E+2
RA-226	2.96E+1	0.45E+1	U-234	6.33E+0	1.06E+0
RA-228	9.55E-1	2.97E-1	U-235/236	<6.0E-1	
			U-238	6.33E+0	1.06E+0
			TH-230	1.39E+3	0.27E+3
			TH-232	4.11E+0	1.12E+0

SAMPLE ID B1-C FRACTION 15A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.16E+1	0.20E+1	GROSS ALPHA	1.81E+3	0.37E+3
CS-137	3.21E-1	0.90E-1	GROSS BETA	2.74E+2	0.58E+2
RA-226	2.40E+1	0.37E+1	U-234	7.44E+0	1.04E+0
RA-228	1.29E+0	0.24E+0	U-235/236	<6.0E-1	
			U-238	7.00E+0	0.99E+0
			TH-230	1.43E+3	0.36E+3
			TH-232	6.69E+0	2.15E+0

SAMPLE ID B2-A FRACTION 16A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	9.40E+0	1.83E+0	GROSS ALPHA	7.81E+3	1.57E+3
CS-137	<2.0E+1		GROSS BETA	9.69E+2	1.97E+2
RA-226	1.51E+1	0.19E+1	U-234	1.80E+1	0.24E+1
RA-228	1.25E+0	0.36E+0	U-235/236	2.13E+0	0.44E+0
			U-238	1.14E+1	0.16E+1
			TH-230	3.72E+3	0.78E+3
			TH-232	4.53E+0	1.31E+0

SAMPLE ID B1-C FRACTION 15A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.16E+1	0.20E+1	GROSS ALPHA	1.81E+3	0.37E+3
CS-137	3.21E-1	0.90E-1	GROSS BETA	2.74E+2	0.58E+2
RA-226	2.40E+1	0.37E+1	U-234	7.44E+0	1.04E+0
RA-228	1.29E+0	0.26E+0	U-235/236	<6.0E-1	
			U-238	7.00E+0	0.99E+0
			TH-230	1.43E+3	0.36E+3
			TH-232	6.69E+0	2.15E+0

SAMPLE ID B2-A FRACTION 16A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	9.40E+0	1.83E+0	GROSS ALPHA	7.81E+3	1.57E+3
CS-137	<2.0E+1		GROSS BETA	9.69E+2	1.97E+2
RA-226	1.51E+1	0.19E+1	U-234	1.80E+1	0.24E+1
RA-228	1.25E+0	0.36E+0	U-235/236	2.13E+0	0.44E+0
			U-238	1.14E+1	0.16E+1
			TH-230	3.72E+3	0.78E+3
			TH-232	4.53E+0	1.31E+0

Received: 04/13/90

ITRSL Oak Ridge REPORT
Results by Sample

Work Order # S0-04-048

SAMPLE ID B2-B FRACTION 17A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	9.16E+0	1.72E+0	GROSS ALPHA	5.56E+3	1.12E+3
CS-137	<2.0E-1		GROSS BETA	7.76E+2	1.59E+2
RA-226	5.93E+1	0.47E+1	U-234	1.13E+1	0.15E+1
RA-228	1.16E+0	0.31E+0	U-235/236	<6.0E-1	
			U-238	6.53E+0	0.92E+0
			TH-230	2.82E+3	0.58E+3
			TH-232	1.31E+1	0.30E+1

SAMPLE ID B2-C FRACTION 18A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g VERIFIED BY RDJ
WRTN 05/15/90

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	9.53E+0	1.61E+0	GROSS ALPHA	1.08E+3	0.22E+3
CS-137	<2.0E-1		GROSS BETA	1.49E+2	0.35E+2
RA-226	9.88E+0	1.59E+0	U-234	1.98E+0	0.33E+0
RA-228	9.90E-1	1.73E-1	U-235/236	6.61E-1	1.62E-1
			U-238	2.14E+0	0.35E+0
			TH-230	5.74E+2	1.13E+2
			TH-232	1.16E+0	0.49E+0

Received: 04/13/90

ITRSL Oak Ridge REPORT
Results by Sample

Work Order # SO-04-048

SAMPLE ID BKG

FRACTION 19A TEST CODE GS NAME GAMMA SPEC
Date & Time Collected 04/12/90 Category

UNITS pCi/g
WRTN 05/15/90

VERIFIED BY RDJ

GAMMA SPEC	RESULT	2-SIGMA	OTHER	RESULT	2-SIGMA
K-40	1.81E+1	0.29E+1	GROSS ALPHA	3.30E+1	1.14E+1
CS-137	<2.0E-1		GROSS BETA	2.79E+1	0.96E+1
RA-226	1.09E+0	0.12E+0	U-234	1.13E+0	0.31E+0
RA-228	1.32E+0	0.18E+0	U-235/236	<6.0E-1	
			U-238	1.11E+0	0.31E+0
			TH-230	3.55E+0	0.61E+0
			TH-232	1.54E+0	0.33E+0

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

May 7, 1990

David Purington
DAMES & MOORE
11701 Borman Drive, Suite 340
St. Louis, Missouri 63146

Project: 19943 - 002; Ford Earth City

Dear Mr. Purington:

Enclosed are the analytical results for your samples received in our laboratory on April 17, 1990, for the above captioned project.

All the samples were originally extracted on April 17, 1990. The acid surrogates were outside QC limits for sample MW105, MW106 and MW107. These samples were re-extracted on April 26, 1990 and re-analyzed on May 1, 1990. The acid surrogates also did not meet the recovery criteria for sample MW105 and MW106. This indicated a matrix effect. We have reported the data from the reanalyses for these three sampls.

Per your request we have preformed a matrix spike and duplicate for the following samples;

MW101 (cyanide), MW105 (metals)

Additional Matrix Spike/Matrix Spike Duplicates will follow with the completion of the remaining portion of this project.

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

Randy Staggs
Project Manager

RS/jl

Enclosures

DAMES & MOORE
MAY 08 1990
ST. LOUIS, MISSOURI

1700 WEST ALBANY, SUITE C • BROKEN ARROW, OK 74012
(918) 251-2858 • FAX (918) 251-2599

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.01M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.01
DATE SUBMITTED: 04-17-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW101

RAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TAL CYANIDE	0.02	mg/L	ND	04-27-90	SM 412D
OTAL METALS					
SENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
EAD	3.0	ug/L	ND	05-01-90	EPA 239.2
ERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
LENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
ALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
NTIMONY	30.0	ug/L	ND	04-25-90	EPA 200.7
RYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
DMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
HROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
OPPER	10.0	ug/L	152	04-25-90	EPA 200.7
CKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
ILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
INC	10.0	ug/L	102	04-25-90	EPA 200.7

PA = #EPA600/4-79-020, MARCH 1985
D = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858

IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.01H

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.01
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW101

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 85%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.01P

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.01
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-01-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW101

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 94%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CL ENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.01V

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.01
DATE SUBMITTED: 04-17-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW101

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
OROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
MOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
NYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
OROETHANE	10	ND	TRICHLOROETHENE	5	ND
HYLENE CHLORIDE	5	18 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	5 J	1,1,2-TRICHLOROETHANE	5	ND
BON DISULFIDE	5	ND	BENZENE	5	ND
-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
LOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
C RBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
OMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 93% 1,2-DICHLOROETHANE-d4(76-114) 97%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

:S & MOORE
70[redacted] BORMAN DRIVE, SUITE 340
[redacted]OUIS, MO 63146
N: DAVID PURINGTON

REPORT: 2388.01B

DATE: 05-07-90

MP[redacted]E MATRIX: WATER
[redacted]# 2388.01
IOD REF.: SW846-8270, EPA METHODOLOGY
OJ[redacted]CT: 19943 - 002; FORD EARTH CITY
MP[redacted]E ID: MW101

DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

MI[redacted]OLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
OL	10	ND	ACENAPHTHENE	10	ND
S[redacted]-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
[redacted]LOROPHENOL	10	ND	4-NITROPHENOL	50	ND
-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
[redacted]ICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
NZ[redacted]L ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]HYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
S[redacted]-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
THYLPHENOL	10	ND	4-NITROANILINE	50	ND
TROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
X[redacted]HLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
TROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
PHORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted]ROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
4[redacted]DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
OIC ACID	50	ND	ANTHRACENE	10	ND
[redacted]-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
4[redacted]DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
HTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
C[redacted]LOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
XACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
HLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
[redacted]HYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
X[redacted]HLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted]-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
C[redacted]LORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
ETHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted]PHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
N[redacted]TROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]OBENZENE-d5(35-114) 55% 2-FLUOROBIPHENYL(43-116) 51% TERPHENYL-d14 (33-141) 68%
[redacted]OL-d5 (10-94) 68% 2-FLUOROPHENOL (21-100) 48% 2,4,6-TRIBROMOPHENOL(10-123) 60%

[redacted] NOT DETECTED ABOVE QUANTITATION LIMIT
ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.02M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.02
DATE SUBMITTED: 04-17-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW105

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.02	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	ND	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	73	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	489	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE REPORT: 2388.02H
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146 DATE: 05-07-90
ATTN: DAVID PURINGTON

SAMPLE MATRIX: WATER
SWLO # 2388.02
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW105

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 91.2%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.02P

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.02
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-01-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW105

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 65%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CL NT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.02V

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.02
DATE SUBMITTED: 04-17-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW105

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

'O TILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
ROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
R OMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
NYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
LOROETHANE	10	ND		TRICHLOROETHENE	5	ND
E YLENE CHLORIDE	5	18	B	DIBROMOCHLOROMETHANE	5	ND
ONE	10	6	J	1,1,2-TRICHLOROETHANE	5	ND
RBON DISULFIDE	5	ND		BENZENE	5	ND
-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
, -DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
OROFORM	5	ND		2-HEXANONE	10	ND
, -DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
ON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
L ACETATE	10	ND		ETHYLBENZENE	5	ND
OMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

T UENE-d8(88-110) 103% BROMOFLUOROBENZENE(86-115) 90% 1,2-DICHLOROETHANE-d4(76-114) 103%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ES & MOORE
70[redacted] BORMAN DRIVE, SUITE 340
. [redacted]UIS, MO 63146
N: DAVID PURINGTON

REPORT: 2388.02B

DATE: 05-07-90

MP[redacted]E MATRIX: WATER
O # 2388.02
HOD REF.: SW846-8270, EPA METHODOLOGY
OJ[redacted]CT: 19943 - 002; FORD EARTH CITY
MP[redacted]E ID: MW105

DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-26-90
DATE ANALYZED : 05-01-90

[redacted]OLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
N[redacted]L	10	ND	ACENAPHTHENE	10	ND
S[redacted]-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
CHLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
3-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
4[redacted]ICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
N[redacted]L ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
2-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]HYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
S[redacted]-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]TROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
[redacted]CHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
ITROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
OPHORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted]TROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
.[redacted]DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
NZOIC ACID	50	ND	ANTHRACENE	10	ND
[redacted]2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
,[redacted]DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
[redacted]LOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
EX[redacted]CHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
CHLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	2 J
[redacted]THYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
E[redacted]CHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
-4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted]5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
[redacted]LORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
-NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted]NAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
[redacted]ITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5(35-114) 87% 2-FLUOROBIPHENYL(43-116) 74% TERPHENYL-d14 (33-141) 85%
[redacted]NOL-d5 (10-94) 17% 2-FLUOROPHENOL (21-100) 5%x 2,4,6-TRIBROMOPHENOL(10-123) 10%

[redacted]= NOT DETECTED ABOVE QUANTITATION LIMIT
[redacted]= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.03M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.03
DATE SUBMITTED: 04-17-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW106

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	44.7	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	80	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	56.4	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.03H

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.03
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW106

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 91.7%

) = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.03P

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.03
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-01-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW106

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 70%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.03V

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.03
DATE SUBMITTED: 04-17-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW106

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	19	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	4	J	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	ND		2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 94% 1,2-DICHLOROETHANE-d4(76-114) 103%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted] & MOORE
70[redacted] BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
: DAVID PURINGTON

REPORT: 2388.03B

DATE: 05-07-90

[redacted]E MATRIX: WATER
\# 2388.03
D REF.: SW846-8270, EPA METHODOLOGY
[redacted]CT: 19943 - 002; FORD EARTH CITY
LE ID: MW106

DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-26-90
DATE ANALYZED : 05-01-90

VOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
E[redacted]L	10	ND	ACENAPHTHENE	10	ND
[redacted]-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
LOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]ICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
4[redacted]ICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
YL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
[redacted]DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
M[redacted]HYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
[redacted]-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
THYLPHENOL	10	ND	4-NITROANILINE	50	ND
N[redacted]ROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
X[redacted]HLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
OBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]HORONE	10	ND	HEXACHLOROBENZENE	10	ND
N[redacted]TROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
OIC ACID	50	ND	ANTHRACENE	10	ND
[redacted]-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
4[redacted]DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
C[redacted]LOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
CHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]LORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	27
[redacted]THYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
XACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted]5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
-C[redacted]LORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
TROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]THYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted]APHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
-NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]OBENZENE-d5(35-114) 87% 2-FLUOROBIPHENYL(43-116) 73% TERPHENYL-d14 (33-141) 76%
OL-d5 (10-94) 25% 2-FLUOROPHENOL (21-100) 8%* 2,4,6-TRIBROMOPHENOL(10-123) 15%

[redacted] = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.04M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.04
DATE SUBMITTED: 04-17-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW107

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	33.1	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	62	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	10.9	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	43.0	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.04H

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.04
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW107

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98)	89%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.04P

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.04
DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW107

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 68%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CL ENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.04V

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.04
DATE SUBMITTED: 04-17-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW107

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

LATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
C LOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
OMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
NYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
LOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	16	B	DIBROMOCHLOROMETHANE	5	ND
ETONE	10	3	J	1,1,2-TRICHLOROETHANE	5	ND
RBON DISULFIDE	5	ND		BENZENE	5	ND
1, -DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
LOROFORM	5	ND		2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
NYL ACETATE	10	ND		ETHYLBENZENE	5	ND
OMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

LUENE-d8(88-110) 96% BROMOFLUOROBENZENE(86-115) 92% 1,2-DICHLOROETHANE-d4(76-114) 100%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted]S & MOORE
17[redacted]1 BORMAN DRIVE, SUITE 340
[redacted]LOUIS, MO 63146
TN: DAVID PURINGTON

REPORT: 2388.04B

DATE: 05-07-90

A[redacted]LE MATRIX: WATER
LO # 2388.04
[redacted]OD REF.: SW846-8270, EPA METHODOLOGY
R[redacted]ECT: 19943 - 002; FORD EARTH CITY
MPLE ID: MW107

DATE SUBMITTED: 04-17-90
DATE EXTRACTED: 04-26-90
DATE ANALYZED : 05-01-90

[redacted]IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
TH[redacted]OL	10	ND	ACENAPHTHENE	10	ND
I[redacted]2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
CHLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
[redacted]-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
ENZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]ETHYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
BIS(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]ITROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
E[redacted]ACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
TROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]PHORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted]ITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
2,4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
NZOIC ACID	50	ND	ANTHRACENE	10	ND
[redacted](2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
2,4-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]HTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
4[redacted]HLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
EXACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]HLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
[redacted]ETHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted],5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
A[redacted]NAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
3-NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]TROBENZENE-d5	(35-114)	82%	2-FLUOROBIPHENYL(43-116)	68%	TERPHENYL-d14	(33-141)	89%
ENOL-d5	(10-94)	59%	2-FLUOROPHENOL (21-100)	29%	2,4,6-TRIBROMOPHENOL	(10-123)	51%

[redacted] = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
[redacted] = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

.I T: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2388.05V

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2388.05
DATE SUBMITTED: 04-17-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: TR-1

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

ATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
ROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
RO OMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
NYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
ROETHANE	10	ND		TRICHLOROETHENE	5	ND
E YLENE CHLORIDE	5	2	J	DIBROMOCHLOROMETHANE	5	ND
TONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
BON DISULFIDE	5	ND		BENZENE	5	ND
, DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
ROFORM	5	6	B	2-HEXANONE	10	ND
, DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
UTANONE	10	ND		TETRACHLOROETHENE	5	ND
1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
A ON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
NYL ACETATE	10	ND		ETHYLBENZENE	5	ND
OMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

LUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 93% 1,2-DICHLOROETHANE-d4(76-114) 102%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ANALYTICAL REPORT

DAMES & MOORE
11701 Borman Drive
St. Louis. Missouri 63149

REPORT: G2705

REPORT DATE: 05/03/90

SWLO IDENTIFICATION

SAMPLE NO.: 2388.01 - 2388.05
DATE RECEIVED: 04/17/90

QA/QC

DESCRIPTION		PARAMETER	RESULTS	
METHOD BLANK	04/25/90	ANTIMONY	<30	ug/L
METHOD BLANK	04/25/90	BERYLLIUM	<5	ug/L
METHOD BLANK	04/25/90	CADMIUM	<5	ug/L
METHOD BLANK	04/25/90	CHROMIUM	<5	ug/L
METHOD BLANK	04/25/90	COPPER	<10	ug/L
METHOD BLANK	04/25/90	NICKEL	<10	ug/L
METHOD BLANK	04/25/90	SILVER	<10	ug/L
METHOD BLANK	04/25/90	ZINC	<10	ug/L
BLANK SPIKE	04/25/90	ANTIMONY	102%	RECOVERY
BLANK SPIKE	04/25/90	BERYLLIUM	100%	RECOVERY
BLANK SPIKE	04/25/90	CADMIUM	115%	RECOVERY
BLANK SPIKE	04/25/90	CHROMIUM	98%	RECOVERY
BLANK SPIKE	04/25/90	COPPER	104%	RECOVERY
BLANK SPIKE	04/25/90	NICKEL	99%	RECOVERY
BLANK SPIKE	04/25/90	SILVER	86%	RECOVERY
BLANK SPIKE	04/25/90	ZINC	110%	RECOVERY
MATRIX SPIKE	MW105	ANTIMONY	102%	RECOVERY
MARTIX SPIKE	MW105	BERYLLIUM	100%	RECOVERY
MATRIX SPIKE	MW105	CADMIUM	115%	RECOVERY
MATRIX SPIKE	MW105	CHROMIUM	98%	RECOVERY
MATRIX SPIKE	MW105	COPPER	107%	RECOVERY
MATRIX SPIKE	MW105	NICKEL	99%	RECOVERY
MATRIX SPIKE	MW105	SILVER	86%	RECOVERY
MATRIX SPIKE	MW105	ZINC	110%	RECOVERY
DUPLICATE	MW101	ANTIMONY	0%	RPD
DUPLICATE	MW101	BERYLLIUM	0%	RPD
DUPLICATE	MW101	CADMIUM	0%	RPD
DUPLICATE	MW101	CHROMIUM	0%	RPD
DUPLICATE	MW101	COPPER	17%	RPD
DUPLICATE	MW101	NICKEL	0%	RPD
DUPLICATE	MW101	SILVER	0%	RPD
DUPLCATE	MW101	ZINC	24%	RPD

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ANALYTICAL REPORT

DAMES & MOORE
11701 Borman Drive
St. Louis. Missouri 63149

REPORT: G2705.2

REPORT DATE: 05/03/90

SWLO IDENTIFICATION

SAMPLE NO.: 2388.01 - 2388.05
DATE RECEIVED: 04/17/90

QA/QC

DESCRIPTION	PARAMETER	RESULTS	
METHOD BLANK 04/30/90	ARSENIC	<10	ug/L
METHOD BLANK 05/01/90	LEAD	<3	ug/L
METHOD BLANK 05/02/90	SELENIUM	<5	ug/L
METHOD BLANK 05/01/90	THALLIUM	<10	ug/L
METHOD BLANK 04/27/90	TOTAL CYANIDE	<.01	mg/L
BLANK SPIKE 04/30/90	ARSENIC	101%	RECOVERY
BLANK SPIKE 04/30/90	ARSENIC	81%	RECOVERY
BLANK SPIKE 05/01/90	LEAD	99%	RECOVERY
BLANK SPIKE 05/01/90	LEAD	98%	RECOVERY
BLANK SPIKE 05/02/90	SELENIUM	98%	RECOVERY
BLANK SPIKE 05/02/90	SELENIUM	88%	RECOVERY
BLANK SPIKE 05/01/90	THALLIUM	98%	RECOVERY
BLANK SPIKE 05/01/90	THALLIUM	95%	RECOVERY
MATRIX SPIKE MW101	ARSENIC	96%	RECOVERY
MARTIX SPIKE MW107	LEAD	64%	RECOVERY
MATRIX SPIKE MW107	SELENIUM	70%	RECOVERY
MATRIX SPIKE MW107	THALLIUM	110%	RECOVERY
MATRIX SPIKE MW101	TOTAL CYANIDE	104%	RECOVERY
DUPLICATE MW101	ARSENIC	0%	RPD
DUPLICATE MW106	LEAD	0%	RPD
DUPLICATE MW101	SELENIUM	0%	RPD
DUPLICATE MW106	THALLIUM	0%	RPD
DUPLICATE MW101	TOTAL CYANIDE	0%	RPD

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 32705.3

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 81.7%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2705.4

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-01-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 135%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2705.5

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

OLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
HLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
ROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
INYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
HLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
ETHYLENE CHLORIDE	5	10	DIBROMOCHLOROMETHANE	5	ND
CETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
ARBON DISULFIDE	5	ND	BENZENE	5	ND
,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
RANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
HLOROFORM	5	ND	2-HEXANONE	10	ND
,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
ARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
INYL ACETATE	10	ND	ETHYLBENZENE	5	ND
ROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

OLUENE-d8(88-110) 100% BROMOFLUOROBENZENE(86-115) 86% 1,2-DICHLOROETHANE-d4(76-114) 95%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted]ES & MOORE
[redacted]01 BORMAN DRIVE, SUITE 340
. LOUIS, MO 63146
TN: DAVID FURINGTON

REPORT: G2705.6

DATE: 05-07-90

[redacted]PLE MATRIX: WATER
ILO # METHOD BLANK
[redacted]HOD REF.: SW846-8270, EPA METHODOLOGY
[redacted]JECT: 19943 - 002; FORD EARTH CITY
MPLE ID: METHOD BLANK

DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

[redacted]IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
[redacted]NOL	10	ND	ACENAPHTHENE	10	ND
[redacted](2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
-CHLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
[redacted]-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
ENZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]ETHYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
[redacted](2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]ITROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
[redacted]ACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
TROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]PHORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted]NITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
2,4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
NZOIC ACID	50	ND	ANTHRACENE	10	ND
[redacted](2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
[redacted]-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]HTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
[redacted]CHLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
HEXACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]CHLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
[redacted]ETHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
HEXACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted],5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
[redacted]CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
2-NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted]ENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
3-NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]TROBENZENE-d5(35-114)	62%	2-FLUOROBIPHENYL(43-116)	55%	TERPHENYL-d14 (33-141)	77%
ENOL-d5 (10-94)	83%	2-FLUOROPHENOL (21-100)	59%	2,4,6-TRIBROMOPHENOL(10-123)	65%

[redacted] = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

MES & MOORE	REPORT: G2705.7
701 BORMAN DRIVE, SUITE 340	
. LOUIS, MO 63146	DATE: 05-07-90
TN: DAVID PURINGTON	
MPLE MATRIX: WATER	
LD # METHOD BLANK	DATE EXTRACTED: 04-17-90
THOD REF.: SW846-8270, EPA METHODOLOGY	DATE ANALYZED : 04-26-90
OJECT: 19943 - 002; FORD EARTH CITY	
MPLE ID: METHOD BLANK	

MIVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
ENOL	10	ND	ACENAPHTHENE	10	ND
S(2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
CHLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
3-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
4-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
NZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
2-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
-METHYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
S(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND
NITROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
XACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
TROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
OPHORONE	10	ND	HEXACHLOROBENZENE	10	ND
NITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
NZOIC ACID	50	ND	ANTHRACENE	10	ND
S(2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
4-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
PHTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
CHLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
XACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
CHLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
METHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
XACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
4,5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
ENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(35-114)	78%	2-FLUOROBIPHENYL	(43-116)	69%	TERPHENYL-d14	(33-141)	89%
ENOL-d5	(10-94)	90%	2-FLUOROPHENOL	(21-100)	64%	2,4,6-TRIBROMOPHENOL	(10-123)	77%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

May 8, 1990

David Purington
DAMES & MOORE
11701 Borman Drive, Suite 340
St. Louis, Missouri 63146

Project: 19943 - 002; Ford Earth City

Dear Mr. Purington:

Enclosed are the analytical results for your samples received in our laboratory on April 18, 1990, for the above captioned project.

Sample MW110 was originally extracted on April 19, 1990. The QC/MS analysis indicated that the surrogates did not meet the QC criteria. Hence, this sample was re-extracted on April 24, 1990, and later re-analysed. The data was reported for the re-analysed sample.

Per your request we have preformed a matrix spike and duplicate for the following samples; MW102 (semi-volatile), MW108 (Herbicides), MW110 (Pesticides), MW104 (Volatile)

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

Randy Staggs
Project Manager

DAMES & MOORE
MAY 09 1990
ST. LOUIS, MISSOURI

RS/jl

Enclosures

1700 West Albany, Suite C • Broken Arrow, OK 74012
(918) 251-2858 • Fax (918) 251-2599

[redacted]

314-993-4599

2 boxes

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: Ford		Field Personnel (Signature)
Project Title	Job No. 19943-002	

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4-17	9:00	MW110	water	7		VOC, Semi, pest, herb, [illegible]
	10:00	MW102		7		
	10:30	MW108		7		
	13:30	MW103		7		
	14:30	MW104		7		
		TR-2		2		VOC

CW

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
[illegible signature]	4/17	5:00	[illegible signature]	4/18/00	0900						
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.01M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2397.01
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW110

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	05-01-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	ND	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	102	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	40.5	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.01H

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.01
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW110

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98)	89.4%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.01P

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.01
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW110

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.1	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.1	ND
AROCHLOR-1260	1.1	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 100%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.01V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.01
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW110

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	16 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	4 JB	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 96% BROMOFLUOROBENZENE(86-115) 92% 1,2-DICHLOROETHANE-d4(76-114) 100%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

A[redacted]S & MOORE
1[redacted]1 BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
[redacted]N: DAVID PURINGTON

REPORT: 2397.01B

DATE: 05-08-90

[redacted]PLE MATRIX: WATER
O # 2397.01
E[redacted]HOD REF.: SW846-8270, EPA METHODOLOGY
[redacted]JECT: 19943 - 002; FORD EARTH CITY
PLE ID: MW110

DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-24-90
DATE ANALYZED : 04-25-90

IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
H[redacted]OL	20	ND	ACENAPHTHENE	20	ND
[redacted](2-CHLOROETHYL)ETHER	20	ND	2,4-DINITROPHENOL	100	ND
CHLOROPHENOL	20	ND	4-NITROPHENOL	100	ND
[redacted]-DICHLOROBENZENE	20	ND	DIBENZOFURAN	20	ND
[redacted]-DICHLOROBENZENE	20	ND	2,4-DINITROTOLUENE	20	ND
ZYL ALCOHOL	20	ND	2,6-DINITROTOLUENE	20	ND
-DICHLOROBENZENE	20	ND	DIETHYLPHTHALATE	20	8 J
[redacted]ETHYLPHENOL	20	ND	4-CHLOROPHENYL-PHENYLETHER	20	ND
(2-CHLOROISOPROPYL)ETHER	20	ND	FLUORENE	20	ND
IETHYLPHENOL	20	ND	4-NITROANILINE	100	ND
[redacted]ITROSO-DI-n-PROPYLAMINE	20	ND	4,6-DINITRO 2-METHYLPHENOL	100	ND
[redacted]ACHLOROETHANE	20	ND	N-NITROSODIPHENYLAMINE(1)	20	ND
TROBENZENE	20	ND	4-BROMOPHENYL-PHENYLETHER	20	ND
[redacted]PHORONE	20	ND	HEXACHLOROBENZENE	20	ND
[redacted]ITROPHENOL	20	ND	PENTACHLOROPHENOL	20	ND
I-DIMETHYLPHENOL	20	ND	PHENANTHRENE	20	ND
ZOIC ACID	100	ND	ANTHRACENE	20	ND
[redacted](2-CHLOROETHOXY)METHANE	20	ND	DI-N-BUTYLPHTHALATE	20	ND
[redacted]-DICHLOROPHENOL	20	ND	FLUORANTHENE	20	ND
2,4-TRICHLOROBENZENE	20	ND	PYRENE	20	ND
[redacted]HTHALENE	20	ND	BUTYLBENZYLPHTHALATE	20	ND
[redacted]HLOROANILINE	20	ND	3,3-DICHLOROBENZIDINE	40	ND
ACHLOROBUTADIENE	20	ND	BENZO(A)ANTHRACENE	20	ND
HLORO-3-METHYLPHENOL	20	ND	BIS(2-ETHYLHEXYL)PHTHALATE	20	ND
[redacted]ETHYLNAPHTHALENE	20	ND	CHRYSENE	20	ND
ACHLOROCYCLOPENTADIENE	20	ND	DI-N-OCTYL PHTHALATE	20	ND
,6-TRICHLOROPHENOL	20	ND	BENZO(B)FLUORANTHENE	20	ND
[redacted],5-TRICHLOROPHENOL	100	ND	BENZO(K)FLUORANTHENE	20	ND
[redacted]HLORONAPHTHALENE	20	ND	BENZO(A)PYRENE	20	ND
NITROANILINE	100	ND	INDENO(1,2,3-CD)PYRENE	20	ND
[redacted]ETHYLPHTHALATE	20	ND	DIBENZ(A,H)ANTHRACENE	20	ND
[redacted]NAPHTHYLENE	20	ND	BENZO(G,H,I)PERYLENE	20	ND
NITROANILINE	100	ND			

QA/QC SURROGATE RECOVERIES

N[redacted]ROBENZENE-d5(35-114)	65%	2-FLUOROBIPHENYL(43-116)	62%	TERPHENYL-d14 (33-141)	83%
P[redacted]NOL-d5 (10-94)	36%	2-FLUOROPHENOL (21-100)	18%*	2,4,6-TRIBROMOPHENOL(10-123)	21%

N[redacted] = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.02M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2397.02
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW102

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	ND	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	326	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	13.8	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	52.8	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.02H

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.02
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW102

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 93.7%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.02P

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.02
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW102

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 83%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.02V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.02
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW102

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	16 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	3 J	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 98% BROMOFLUOROBENZENE(86-115) 94% 1,2-DICHLOROETHANE-d4(76-114) 100%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ES & MOORE
1 BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
N: DAVID PURINGTON

REPORT: 2397.02B

DATE: 05-08-90

PLE MATRIX: WATER
O # 2397.02
HOD REF.: SW846-8270, EPA METHODOLOGY
JECT: 19943 - 002; FORD EARTH CITY
PLE ID: MW102

DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-24-90

IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)	
NOL	10	ND	ACENAPHTHENE	10	ND	
(2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND	
HLOROPHENOL	10	ND	4-NITROPHENOL	50	ND	
-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND	
-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND	
ZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND	
-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND	
ETHYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND	
(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND	
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND	
ITROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO. 2-METHYLPHENOL	50	ND	
ACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND	
ROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND	
PHORONE	10	ND	HEXACHLOROBENZENE	10	ND	
ITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND	
4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND	
ZOIC ACID	50	ND	ANTHRACENE	10	ND	
(2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND	
4-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND	
2,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND	
HTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND	
CHLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND	
ACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND	
CHLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	2	JB
METHYLNAPHTHALENE	10	ND	CHRYSENE	10	1	J
EXACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND	
4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND	
4,5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND	
CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND	
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND	
METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND	
ENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND	
NITROANILINE	50	ND				

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(35-114)	71%	2-FLUOROBIPHENYL	(43-116)	68%	TERPHENYL-d14	(33-141)	60%
ENOL-d5	(10-94)	49%	2-FLUOROPHENOL	(21-100)	35%	2,4,6-TRIBROMOPHENOL	(10-123)	34%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.03M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2397.03
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW108

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	34.5	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	81	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	14.0	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	44.5	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.03H

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.03
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW108

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 87.9%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.03P

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.03
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW108

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 82%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.03V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.03
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW108

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	15 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	3 J	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 100% BROMOFLUOROBENZENE(86-115) 95% 1,2-DICHLOROETHANE-d4(76-114) 103%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted] & MOORE
.7[redacted] BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
[redacted] DAVID PURINGTON

REPORT: 2397.03B

DATE: 05-08-90

MPLE MATRIX: WATER
[redacted] # 2397.03
[redacted]D REF.: SW846-8270, EPA METHODOLOGY
ROJECT: 19943 - 002; FORD EARTH CITY
PLE ID: MW108

DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-24-90

IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
[redacted]OL	10	ND	ACENAPHTHENE	10	ND
IS(2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
HLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
,4-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
ZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
[redacted]DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]THYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
IS(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
[redacted]THYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]TROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
XACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
OBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]HORONE	10	ND	HEXACHLOROBENZENE	10	ND
-NITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
,4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
[redacted]OIC ACID	50	ND	ANTHRACENE	10	ND
[redacted]2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
,4-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
[redacted]4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
-CHLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
XACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]LORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
-METHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
XACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
[redacted]6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted]5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
-CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
[redacted]TROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]ETHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
CENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
-NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]ROBENZENE-d5(35-114)	78%	2-FLUOROBIPHENYL(43-116)	66%	TERPHENYL-d14	(33-141)	65%
HENOL-d5 (10-94)	42%	2-FLUOROPHENOL (21-100)	29%	2,4,6-TRIBROMOPHENOL(10-123)		23%

U = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
[redacted]= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted]= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.04M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2397.04
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW103

RAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TAL METALS					
SENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
AD	3.0	ug/L	ND	05-01-90	EPA 239.2
RCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
ELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
ALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
TIMONY	30.0	ug/L	34.5	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
DMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
HROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	43	04-25-90	EPA 200.7
ICKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
LVER	10.0	ug/L	ND	04-25-90	EPA 200.7
INC	10.0	ug/L	34.1	04-25-90	EPA 200.7

PA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
M = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.04H

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.04
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-03-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW103

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 84.5%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.04P

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.04
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW103

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.1	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.1	ND
AROCHLOR-1260	1.1	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 61%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.04V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.04
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-20-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW103

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
OROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
INYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
OROETHANE	10	ND	TRICHLOROETHENE	5	ND
M HYLENE CHLORIDE	5	26 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	17 B	1,1,2-TRICHLOROETHANE	5	ND
RBON DISULFIDE	5	ND	BENZENE	5	ND
-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
OROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
,1-TRICHLOROETHANE	5	ND	TOLUENE	5	8
RBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	2 J
OMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	10

QA/QC SURROGATE RECOVERIES

LUENE-d8(88-110) 99% BROMOFLUOROBENZENE(86-115) 94% 1,2-DICHLOROETHANE-d4(76-114) 93%

= NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted] & MOORE
[redacted] BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
[redacted]: DAVID PURINGTON

REPORT: 2397.04B

DATE: 05-08-90

LE MATRIX: WATER
[redacted] # 2397.04
[redacted]OD REF.: SW846-8270, EPA METHODOLOGY
[redacted]ECT: 19943 - 002; FORD EARTH CITY
PLE ID: MW103

DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-24-90

[redacted]VOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
[redacted]OL	10	ND	ACENAPHTHENE	10	ND
[redacted]2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
HLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
[redacted]DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
ZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
[redacted]DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted]THYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
[redacted](2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
ETHYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]TROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
[redacted]CHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
ROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]HORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted]TROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
[redacted]-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
ZOIC ACID	50	ND	ANTHRACENE	10	ND
[redacted](2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
[redacted]-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
[redacted],4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
[redacted]LOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
[redacted]ACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]LORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
[redacted]ETHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
[redacted]ACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
[redacted],6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted],5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
[redacted]HLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]ETHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted]NAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]TROBENZENE-d5(35-114)	78%	2-FLUOROBIPHENYL(43-116)	75%	TERPHENYL-d14 (33-141)	81%
ENOL-d5 (10-94)	52%	2-FLUOROPHENOL (21-100)	34%	2,4,6-TRIBROMOPHENOL(10-123)	30%

[redacted] = NOT DETECTED ABOVE QUANTITATION LIMIT
[redacted] = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
[redacted] = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.05M

DATE: 05-07-90

SAMPLE MATRIX: WATER
SWLO # 2397.05
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW104

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDE	0.01	mg/L	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-02-90	EPA 206.2
LEAD	3.0	ug/L	ND	05-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	04-25-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	05-02-90	EPA 270.2
THALLIUM	10.0	ug/L	ND	05-01-90	EPA 279.2
ANTIMONY	30.0	ug/L	ND	04-25-90	EPA 200.7
BERYLLIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	04-25-90	EPA 200.7
COPPER	10.0	ug/L	131	04-25-90	EPA 200.7
NICKEL	10.0	ug/L	ND	04-25-90	EPA 200.7
SILVER	10.0	ug/L	ND	04-25-90	EPA 200.7
ZINC	10.0	ug/L	40.7	04-25-90	EPA 200.7

EPA = #EPA600/4-79-020, MARCH 1985
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SM = STANDARD METHOD, 16TH EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

LIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.05H
DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.05
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-03-90
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW104

RESULTS REPORTED IN ug/L OR Parts Per Billion

HERBICIDES	DET. LIMIT	RESULTS
2,4-D	1.0	ND
2,4,5-TP (SILVEX)	0.2	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98)	79.6%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.05P

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.05
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: MW104

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 54%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
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ENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.05V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.05
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW104

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

ATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
OMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
YL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
C OROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	1 JB	DIBROMOCHLOROMETHANE	5	ND
TONE	10	5 JB	1,1,2-TRICHLOROETHANE	5	ND
RBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
ANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
NYL ACETATE	10	ND	ETHYLBENZENE	5	ND
OMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 103% BROMOFLUOROBENZENE(86-115) 95% 1,2-DICHLOROETHANE-d4(76-114) 104%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

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[redacted] & MOORE
[redacted] BORMAN DRIVE, SUITE 340
OUIS, MO 63146
[redacted] DAVID PURINGTON

REPORT: 2397.05B

DATE: 05-08-90

E MATRIX: WATER
2397.05
[redacted] D REF.: SW846-8270, EPA METHODOLOGY
[redacted] CT: 19943 - 002; FORD EARTH CITY
E ID: MW104

DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-24-90

VOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
[redacted] L	10	ND	ACENAPHTHENE	10	ND
-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
OROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted] ICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
[redacted] ICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
YL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
[redacted] ICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
[redacted] HYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
THYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted] ROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
CHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
OBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted] HORONE	10	ND	HEXACHLOROBENZENE	10	ND
[redacted] ROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
[redacted] OIC ACID	50	ND	ANTHRACENE	10	ND
[redacted] -CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted] THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
LOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
CHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted] LORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
[redacted] THYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
XACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
[redacted] 6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted] 5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
LORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
[redacted] TROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted] THYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
[redacted] APHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
TROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted] OBENZENE-d5(35-114)	80%	2-FLUOROBIPHENYL(43-116)	75%	TERPHENYL-d14 (33-141)	75%
ENOL-d5 (10-94)	48%	2-FLUOROPHENOL (21-100)	32%	2,4,6-TRIBROMOPHENOL(10-123)	40%

[redacted] NOT DETECTED ABOVE QUANTITATION LIMIT
ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: 2397.06V

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.06
DATE SUBMITTED: 04-18-90
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: TR-2

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	18	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	2	JB	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	ND		2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 104% BROMOFLUOROBENZENE(86-115) 97% 1,2-DICHLOROETHANE-d4(76-114) 106%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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SOUTHWEST LABORATORY OF OKLAHOMA, INC.
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ANALYTICAL REPORT

DAMES & MOORE
1701 Borman Drive
St. Louis, Missouri 63149

REPORT: G2704

REPORT DATE: 05/03/90

SWLO IDENTIFICATION

SAMPLE NO.: 2397.01 - 2397.06
DATE RECEIVED: 04/18/90

QA/QC

DESCRIPTION	PARAMETER	RESULTS	
METHOD BLANK 05/01/90	LEAD	<3	ug/L
METHOD BLANK 05/01/90	THALLIUM	<10	ug/L
BLANK SPIKE 05/01/90	LEAD	99%	RECOVERY
BLANK SPIKE 05/01/90	LEAD	98%	RECOVERY
BLANK SPIKE 05/01/90	THALLIUM	98%	RECOVERY
BLANK SPIKE 05/01/90	THALLIUM	95%	RECOVERY

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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2704.2

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.03 (MS/MSD)
SAMPLE ID: MW108 (MS/MSD)

HERBICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS

	SPIKE ADDED (ug/L)	AMT. FOUND SMP. (ug/L)	AMT. FOUND MS (ug/L)	MS PERCENT RECOVERY
2,4-D	166.7	0	129.5	77.7
2,4,5-TP (SILVEX)	16.7	0	14.8	88.6

	AMT. FOUND MSD (ug/L)	MSD PERCENT RECOVERY	RECOVERY PERCENT DIFFERENCE
2,4-D	124.8	74.9	3.7
2,4,5-TP (SILVEX)	14.3	85.6	3.4

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CLIENT: DAMES & MOORE
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ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2704.3

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
SAMPLE ID: BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	0.05	ND
BETA-BHC	0.05	ND
DELTA-BHC	0.05	ND
GAMMA-BHC(LINDANE)	0.05	ND
HEPTACHLOR	0.05	ND
ALDRIN	0.05	ND
HEPTACHLOR EPOXIDE	0.05	ND
ENDOSULFAN I	0.05	ND
DIELDRIN	0.1	ND
4,4-DDE	0.1	ND
ENDRIN	0.1	ND
ENDOSULFAN II	0.1	ND
4,4-DDD	0.1	ND
ENDOSULFAN SULFATE	0.1	ND
4,4-DDT	0.1	ND
METHOXYCHLOR	0.5	ND
ENDRIN KETONE	0.1	ND
ALPHA-CHLORDANE	0.5	ND
GAMMA-CHLORDANE	0.5	ND
TOXAPHENE	1.0	ND
AROCHLOR-1016	0.5	ND
AROCHLOR-1221	0.5	ND
AROCHLOR-1232	0.5	ND
AROCHLOR-1242	0.5	ND
AROCHLOR-1248	0.5	ND
AROCHLOR-1254	1.0	ND
AROCHLOR-1260	1.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-154) 95%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
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IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVE PURINGTON

REPORT: G2704.4

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.01 (MS/MSD)
DATE SUBMITTED: 04-18-90
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW110 (MS/MSD)

PESTICIDE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS

	SPIKE ADDED (ug/L)	AMT. FOUND (SAMPLE) (ug/L)	AMT. FOUND (MS) (ug/L)	MS PERCENT RECOVERY
AMMA-BHC	0.40	0	0.45	112.5%
EPTACHLOR	0.40	0	0.44	110.0%
LDRIN	0.40	0	0.43	107.5%
IELDRIN	1.00	0	1.20	120.0%
NDRIN	1.00	0	1.30	130.0%
,4'-DDT	1.00	0	1.30	130.0%

	AMT. FOUND (MSD) (ug/L)	MSD PERCENT RECOVERY	RELATIVE PERCENT DIFFERENCE
AMMA-BHC	0.40	100.0%	11.8%
HEPTACHLOR	0.41	102.5%	7.1%
LDRIN	0.38	95.0%	12.3%
IELDRIN	1.10	110.0%	8.7%
ENDRIN	1.10	110.0%	16.7%
,4'-DDT	1.20	120.0%	8.0%

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2704.5

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 04-18-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

LATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
HLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
ROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
HLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
ETHYLENE CHLORIDE	5	10	DIBROMOCHLOROMETHANE	5	ND
CETONE	10	3 J	1,1,2-TRICHLOROETHANE	5	ND
ARBON DISULFIDE	5	ND	BENZENE	5	ND
,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
HLOROFORM	5	ND	2-HEXANONE	10	ND
,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
ARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
INYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

OLUENE-d8(88-110) 100% BROMOFLUOROBENZENE(86-115) 86% 1,2-DICHLOROETHANE-d4(76-114) 95%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2704.6

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 04-20-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	4 J	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	4 J	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 99% BROMOFLUOROBENZENE(86-115) 94% 1,2-DICHLOROETHANE-d4(76-114) 97%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVE PURINGTON

REPORT: G2704.7

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.05 (MS/MSD)
DATE SUBMITTED: 04-18-90
SAMPLE ID: MW104 (MS/MSD)

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

COMPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS PERCENT RECOVERY	QC LIMITS RECOVERY
1,1-DICHLOROETHENE	50	0	58	116	61 - 145
TRICHLOROETHENE	50	0	54	108	71 - 120
BENZENE	50	0	60	120	76 - 127
TOLUENE	50	0	57	114	76 - 125
CHLOROBENZENE	50	0	54	108	75 - 130

COMPOUND	SPIKE ADDED (ug/L)	MSD CONCENTRATION (ug/L)	MSD PERCENT RECOVERY	PERCENT RPD	QC LIMITS RPD	QC LIMITS REC.
1,1-DICHLOROETHENE	50	56	102	4	14	61 - 145
TRICHLOROETHENE	50	54	108	0	14	71 - 120
BENZENE	50	57	114	5	11	76 - 127
TOLUENE	50	56	112	2	13	76 - 125
CHLOROBENZENE	50	54	108	0	13	75 - 130

* VALUES OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

[redacted] & MOORE
7[redacted] BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
[redacted] DAVID PURINGTON

REPORT: G2704.8
DATE: 05-08-90

[redacted]E MATRIX: WATER
[redacted] # METHOD BLANK
[redacted]D REF.: SW846-8270, EPA METHODOLOGY
[redacted]CT: 19943 - 002; FORD EARTH CITY
LE ID: METHOD BLANK

DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-23-90

VOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
E[redacted]L	10	ND	ACENAPHTHENE	10	ND
S(2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
LOROPHENOL	10	ND	4-NITROPHENOL	50	ND
[redacted]ICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
4[redacted]ICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
YL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
[redacted]ICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
M[redacted]THYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
S(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
[redacted]THYLPHENOL	10	ND	4-NITROANILINE	50	ND
[redacted]ROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
X[redacted]CHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
OBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
[redacted]ORONE	10	ND	HEXACHLOROBENZENE	10	ND
N[redacted]TROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
4-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
OIC ACID	50	ND	ANTHRACENE	10	ND
S[redacted]2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
4-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
[redacted]THALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
-CHLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
ACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
[redacted]LORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	12
-M[redacted]THYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
EXACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
[redacted]6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
[redacted]5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
-CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
ITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
[redacted]THYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
CENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
-NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

[redacted]OBENZENE-d5(35-114)	78%	2-FLUOROBIPHENYL(43-116)	69%	TERPHENYL-d14 (33-141)	94%
HENOL-d5 (10-94)	88%	2-FLUOROPHENOL (21-100)	69%	2,4,6-TRIBROMOPHENOL(10-123)	81%

[redacted] NOT DETECTED ABOVE QUANTITATION LIMIT
_ = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
[redacted] ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
[redacted] SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

S & MOORE
1 BORMAN DRIVE, SUITE 340
LOUIS, MO 63146
: DAVID PURINGTON

REPORT: G2704.9
DATE: 05-08-90

LE MATRIX: WATER
O # METHOD BLANK
OD REF.: SW846-8270, EPA METHODOLOGY
ECT: 19943 - 002; FORD EARTH CITY
PLE ID: METHOD BLANK

DATE EXTRACTED: 04-24-90
DATE ANALYZED : 04-25-90

IVOLATILES	DET. LIMIT	RESULTS (ug/L)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/L)
OL	10	ND	ACENAPHTHENE	10	ND
(2-CHLOROETHYL)ETHER	10	ND	2,4-DINITROPHENOL	50	ND
HLOROPHENOL	10	ND	4-NITROPHENOL	50	ND
-DICHLOROBENZENE	10	ND	DIBENZOFURAN	10	ND
-DICHLOROBENZENE	10	ND	2,4-DINITROTOLUENE	10	ND
ZYL ALCOHOL	10	ND	2,6-DINITROTOLUENE	10	ND
-DICHLOROBENZENE	10	ND	DIETHYLPHTHALATE	10	ND
ETHYLPHENOL	10	ND	4-CHLOROPHENYL-PHENYLETHER	10	ND
(2-CHLOROISOPROPYL)ETHER	10	ND	FLUORENE	10	ND
METHYLPHENOL	10	ND	4-NITROANILINE	50	ND
ITROSO-DI-n-PROPYLAMINE	10	ND	4,6-DINITRO 2-METHYLPHENOL	50	ND
ACHLOROETHANE	10	ND	N-NITROSODIPHENYLAMINE(1)	10	ND
ROBENZENE	10	ND	4-BROMOPHENYL-PHENYLETHER	10	ND
PHORONE	10	ND	HEXACHLOROBENZENE	10	ND
ITROPHENOL	10	ND	PENTACHLOROPHENOL	10	ND
-DIMETHYLPHENOL	10	ND	PHENANTHRENE	10	ND
ZOIC ACID	50	ND	ANTHRACENE	10	ND
(2-CHLOROETHOXY)METHANE	10	ND	DI-N-BUTYLPHTHALATE	10	ND
-DICHLOROPHENOL	10	ND	FLUORANTHENE	10	ND
,4-TRICHLOROBENZENE	10	ND	PYRENE	10	ND
HTHALENE	10	ND	BUTYLBENZYLPHTHALATE	10	ND
HLOROANILINE	10	ND	3,3-DICHLOROBENZIDINE	20	ND
XACHLOROBUTADIENE	10	ND	BENZO(A)ANTHRACENE	10	ND
HLORO-3-METHYLPHENOL	10	ND	BIS(2-ETHYLHEXYL)PHTHALATE	10	ND
METHYLNAPHTHALENE	10	ND	CHRYSENE	10	ND
XACHLOROCYCLOPENTADIENE	10	ND	DI-N-OCTYL PHTHALATE	10	ND
4,6-TRICHLOROPHENOL	10	ND	BENZO(B)FLUORANTHENE	10	ND
,5-TRICHLOROPHENOL	50	ND	BENZO(K)FLUORANTHENE	10	ND
CHLORONAPHTHALENE	10	ND	BENZO(A)PYRENE	10	ND
NITROANILINE	50	ND	INDENO(1,2,3-CD)PYRENE	10	ND
METHYLPHTHALATE	10	ND	DIBENZ(A,H)ANTHRACENE	10	ND
ENAPHTHYLENE	10	ND	BENZO(G,H,I)PERYLENE	10	ND
NITROANILINE	50	ND			

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5(35-114)	60%	2-FLUOROBIPHENYL(43-116)	58%	TERPHENYL-d14 (33-141)	80%
ENOL-d5 (10-94)	37%	2-FLUOROPHENOL (21-100)	41%	2,4,6-TRIBROMOPHENOL(10-123)	65%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

IENT: DAMES & MOORE
11701 BORMAN DRIVE, SUITE 340
ST. LOUIS, MO 63146
ATTN: DAVID PURINGTON

REPORT: G2704.10

DATE: 05-08-90

SAMPLE MATRIX: WATER
SWLO # 2397.02 (MS/MSD)
DATE SUBMITTED: 04-18-90
DATE EXTRACTED: 04-19-90
DATE ANALYZED : 04-24-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: 19943 - 002; FORD EARTH CITY
SAMPLE ID: MW102 (MS/MSD)

SOIL SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

MPOUND	SPIKE ADDED (ug/L)	SAMPLE CONCENTRATION (ug/L)	MS CONCENTRATION (ug/L)	MS PERCENT RECOVERY	QC LIMITS RECOVERY
ENOL	200	0	115	58	26 - 90
-CHLOROPHENOL	200	0	120	60	25 - 102
4-DICHLOROBENZENE	100	0	67	67	28 - 104
NITROSO-di-n-PROPYLAMINE	100	0	56	56	41 - 126
,2,4-TRICHLOROBENZENE	100	0	68	68	38 - 107
CHLORO-3-METHYLPHENOL	200	0	122	61	26 - 103
ENAPHTHENE	100	0	78	78	31 - 137
NITROPHENOL	200	0	179	90*	11 - 114
4-DINITROTOLUENE	100	0	90	90	28 - 89
NTACHLOROPHENOL	200	0	104	52	17 - 109
RENE	100	0	78	78	35 - 142

MPOUND	SPIKE ADDED (ug/Kg)	MSD CONCENTRATION (ug/Kg)	MSD PERCENT RECOVERY	PERCENT RPD	QC LIMITS RPD	QC LIMITS RECOVERY
ENOL	200	123	62	7	35	26 - 90
-CHLOROPHENOL	200	116	58	3	50	25 - 102
4-DICHLOROBENZENE	100	76	76	12	27	28 - 104
NITROSO-di-n-PROPYLAMINE	100	50	50	11	38	41 - 126
1,2,4-TRICHLOROBENZENE	100	70	70	3	23	38 - 107
CHLORO-3-METHYLPHENOL	200	119	60	2	33	26 - 103
ENAPHTHENE	100	77	77	1	19	31 - 137
NITROPHENOL	200	188	94*	4	50	11 - 114
4-DINITROTOLUENE	100	86	86	4	47	28 - 89
NTACHLOROPHENOL	200	117	58	11	47	17 - 109
RENE	100	79	79	1	36	35 - 142

ALUES OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

May 3, 1990

Dave Furington
DAMES & MOORE
11701 Borman Drive
St. Louis, MO 63146

Project: Earth City

Dear Mr. Furington:

Enclosed are the analytical results for your samples received in our laboratory on April 13, 1990, for the above-captioned project.

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

Randy Staggs
Project Manager

RS/lk

Enclosures

DAMES & MOORE
MAY 04 1990
ST. LOUIS, MISSOURI

1700 WEST ALBANY, SUITE C • BROKEN ARROW, OK 74012
(918) 251-2858 • FAX (918) 251-2599

Dave Turington
314-993-4599

DAMES & MOORE CHAIN-OF-CUSTODY RECORD

Sample Source & Client: FORD US Real Estate

Field Personnel (Signature):

Project Title: Earth City

Job No. 19543-002

Date	Time	Sample I.D. No.	Sample Type	No. of Containers	Sampling Site	Remarks
4/12		BKG	Soil	3		TPH, Semi V, Pest, Herb, Met, CN
		S4	sediment	3		
		S3	sediment	3		
		Comp 2	soil	3		
		Comp 1	soil	3		

Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
D. R. [illegible]	4/12	5:00	Missy Akerman	4/13/90	0830						
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time
Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	Received by: (Signature)	Date	Time

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE
ST. LOUIS, MISSOURI 63149
ATTN: DAVE PURINGTON

REPORT: 2371.01MT

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.01
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: BKG

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDES	1.0	ug/Kg	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	2.0	mg/kg	5.80	04-25-90	SW 7060
LEAD	0.6	mg/kg	17.4	04-19-90	SW 7421
MERCURY	0.1	mg/kg	ND	04-18-90	SW 7471
SELENIUM	0.4	mg/kg	ND	04-24-90	SW 7740
THALLIUM	0.4	mg/kg	ND	04-19-90	SW 7841
ANTIMONY	6.0	mg/kg	6.9	04-19-90	SW 6010
BERYLLIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CADMIUM	1.0	mg/kg	1.1	04-19-90	SW 6010
CHROMIUM	1.0	mg/kg	14.5	04-19-90	SW 6010
COPPER	2.0	mg/kg	24.0	04-19-90	SW 6010
NICKEL	2.0	mg/kg	18.0	04-19-90	SW 6010
SILVER	2.0	mg/kg	ND	04-19-90	SW 6010
ZINC	2.0	mg/kg	61.6	04-19-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION #SW846, THIRD EDITION, NOVEMBER 1986
SM = STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 16TH EDITION, 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.01T

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.01
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: BKG

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE EXTRACTED	DATE ANALYZED	METHOD REFERENCE
TOTAL EXTRACTABLE HYDROCARBONS						
GASOLINE	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
DIESEL	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
KEROSENE	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
JP-4	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
NAPTHA	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
BUNKER C/#6 FUEL OIL	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
MISCELLANEOUS (1)	1.0	mg/Kg	14.9	04-19-90	04-20-90	GC/FID

QA/QC SURROGATE RECOVERY

NAPHTHALENE 102%

(1) = ANALYSIS SHOWS MISCELLANEOUS PEAKS WHICH CANNOT BE IDENTIFIED AS ANY SPECIFIC PATTERN. THE RESPONSE FACTOR FOR DIESEL WAS USED.
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = COMPOUND FOUND IN BLANK AS WELL AS SAMPLE
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.01H

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.01
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: BKG

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

ERBICIDES	DET. LIMIT	UNIT	RESULTS
,4-D	80.0	ug/Kg	ND
,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 94.2%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC. REPORT: 2371.01F
11701 BORMAN DRIVE
ST. LOUIS, MO 63149 DATE: 05-03-90
ATTN: DAVID PURINGTON

SAMPLE MATRIX: SOIL
SWLO # 2371.01
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: BKG

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	17.2	ND
BETA-BHC	17.2	ND
GAMMA-BHC(LINDANE)	17.2	ND
DELTA-BHC	17.2	ND
HEPTACHLOR	17.2	ND
ALDRIN	17.2	ND
HEPTACHLOR EPOXIDE	17.2	ND
ENDOSULFAN I	17.2	ND
4,4-DDE	17.2	ND
DIELDRIN	34.5	ND
ENDRIN	34.5	ND
ENDOSULFAN II	34.5	ND
4,4-DDD	34.5	ND
ENDOSULFAN SULFATE	34.5	ND
4,4-DDT	34.5	ND
ENDRIN KETONE	34.5	ND
METHOXYCHLOR	172.4	ND
ALPHA-CHLORDANE	172.4	ND
GAMMA-CHLORDANE	172.4	ND
TOXAPHENE	344.8	ND
AROCHLOR-1221	172.4	ND
AROCHLOR-1232	172.4	ND
AROCHLOR-1242	172.4	ND
AROCHLOR-1016	172.4	ND
AROCHLOR-1248	172.4	ND
AROCHLOR-1254	344.8	ND
AROCHLOR-1260	344.8	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 89%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ES & MOORE, INC.
01 BORMAN DRIVE
LOUIS, MO 63149
N: DAVID PURINGTON

REPORT: 2371.01B

DATE: 05-03-90

PLE MATRIX: SOIL
D # 2371.01
HOD REF.: SW846-8270, EPA METHODOLOGY
JECT: EARTH CITY
PLE ID: BKG

DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

IVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)
NOL	660	ND	ACENAPHTHENE	660	ND
(2-CHLOROETHYL)ETHER	660	ND	2,4-DINITROPHENOL	3200	ND
HLOROPHENOL	660	ND	4-NITROPHENOL	3200	ND
-DICHLOROBENZENE	660	ND	DIBENZOFURAN	660	ND
-DICHLOROBENZENE	660	ND	2,4-DINITROTOLUENE	660	ND
ZYL ALCOHOL	660	ND	2,6-DINITROTOLUENE	660	ND
-DICHLOROBENZENE	660	ND	DIETHYLPHTHALATE	660	ND
ETHYLPHENOL	660	ND	4-CHLOROPHENYL-PHENYLETHER	660	ND
(2-CHLOROISOPROPYL)ETHER	660	ND	FLUORENE	660	ND
ETHYLPHENOL	660	ND	4-NITROANILINE	3200	ND
ITROSO-DI-n-PROPYLAMINE	660	ND	4,6-DINITRO-2-METHYLPHENOL	3200	ND
ACHLOROETHANE	660	ND	N-NITROSODIPHENYLAMINE(1)	660	ND
ROBENZENE	660	ND	4-BROMOPHENYL-PHENYLETHER	660	ND
PHORONE	660	ND	HEXACHLOROBENZENE	660	ND
ITROPHENOL	660	ND	PENTACHLOROPHENOL	660	ND
-DIMETHYLPHENOL	660	ND	PHENANTHRENE	660	ND
ZOIC ACID	3200	ND	ANTHRACENE	660	ND
(2-CHLOROETHOXY)METHANE	660	ND	DI-N-BUTYLPHTHALATE	660	ND
4-DICHLOROPHENOL	660	ND	FLUORANTHENE	660	ND
,4-TRICHLOROBENZENE	660	ND	PYRENE	660	ND
HTHALENE	660	ND	BUTYLBENZYLPHTHALATE	660	ND
CHLOROANILINE	660	ND	3,3-DICHLOROBENZIDINE	1320	ND
ACHLOROBUTADIENE	660	ND	BENZO(A)ANTHRACENE	660	ND
HLORO-3-METHYLPHENOL	660	ND	BIS(2-ETHYLHEXYL)PHTHALATE	660	ND
METHYLNAPHTHALENE	660	ND	CHRYSENE	660	ND
ACHLOROCYCLOPENTADIENE	660	ND	DI-N-OCTYL PHTHALATE	660	ND
,6-TRICHLOROPHENOL	660	ND	BENZO(B)FLUORANTHENE	660	ND
,5-TRICHLOROPHENOL	3200	ND	BENZO(K)FLUORANTHENE	660	ND
CHLORONAPHTHALENE	660	ND	BENZO(A)PYRENE	660	ND
NITROANILINE	3200	ND	INDENO(1,2,3-CD)PYRENE	660	ND
METHYLPHTHALATE	660	ND	DIBENZ(A,H)ANTHRACENE	660	ND
ENAPHTHYLENE	660	ND	BENZO(G,H,I)PERYLENE	660	ND
NITROANILINE	3200	ND			

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(23-120)	73%	2-FLUOROBIPHENYL	(30-115)	79%	TERPHENYL-d14	(18-137)	83%
HENOL-d5	(24-113)	85%	2-FLUOROPHENOL	(25-121)	69%	2,4,6-TRIBROMOPHENOL	(19-122)	88%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE
ST. LOUIS, MISSOURI 63149
ATTN: DAVE PURINGTON

REPORT: 2371.02MT

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.02
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: S4

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDES	1.0	ug/Kg	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	2.0	mg/kg	5.60	04-25-90	SW 7060
LEAD	0.6	mg/kg	17.8	04-19-90	SW 7421
MERCURY	0.1	mg/kg	0.18	04-18-90	SW 7471
SELENIUM	0.4	mg/kg	ND	04-24-90	SW 7740
THALLIUM	0.4	mg/kg	ND	04-19-90	SW 7841
ANTIMONY	6.0	mg/kg	6.7	04-19-90	SW 6010
BERYLLIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CADMIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CHROMIUM	1.0	mg/kg	13.1	04-19-90	SW 6010
COPPER	2.0	mg/kg	23.0	04-19-90	SW 6010
NICKEL	2.0	mg/kg	16.3	04-19-90	SW 6010
SILVER	2.0	mg/kg	ND	04-19-90	SW 6010
ZINC	2.0	mg/kg	56.8	04-19-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION #SW846, THIRD EDITION, NOVEMBER 1986
SM = STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 16TH EDITION, 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.02T

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.02
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: S4

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE EXTRACTED	DATE ANALYZED	METHOD REFERENCE
TOTAL EXTRACTABLE HYDROCARBONS						
GASOLINE	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
DIESEL	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
KEROSENE	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
JP-4	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
NAPTHA	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
BUNKER C/#6 FUEL OIL	1.0	mg/Kg	ND	04-19-90	04-20-90	GC/FID
MISCELLANEOUS (1)	1.0	mg/Kg	6.3	04-19-90	04-20-90	GC/FID

QA/QC SURROGATE RECOVERY

NAPHTHALENE 100%

(1) = ANALYSIS SHOWS MISCELLANEOUS PEAKS WHICH CANNOT BE IDENTIFIED AS ANY SPECIFIC PATTERN. THE RESPONSE FACTOR FOR DIESEL WAS USED.
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = COMPOUND FOUND IN BLANK AS WELL AS SAMPLE
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.02H

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.02
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: S4

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

ERBICIDES	DET. LIMIT	UNIT	RESULTS
2,4-D	80.0	ug/Kg	ND
,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 92.3%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

IENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.02P

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.02
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: S4

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	23.6	ND
BETA-BHC	23.6	ND
GAMMA-BHC(LINDANE)	23.6	ND
DELTA-BHC	23.6	ND
HEPTACHLOR	23.6	ND
ALDRIN	23.6	ND
HEPTACHLOR EPOXIDE	23.6	ND
ENDOSULFAN I	23.6	ND
4,4-DDE	23.6	ND
DIELDRIN	47.2	ND
ENDRIN	47.2	ND
ENDOSULFAN II	47.2	ND
4,4-DDD	47.2	ND
ENDOSULFAN SULFATE	47.2	ND
4,4-DDT	47.2	ND
ENDRIN KETONE	47.2	ND
METHOXYCHLOR	236.0	ND
ALPHA-CHLORDANE	236.0	ND
GAMMA-CHLORDANE	236.0	ND
TOXAPHENE	472.0	ND
AROCHLOR-1221	236.0	ND
AROCHLOR-1232	236.0	ND
AROCHLOR-1242	236.0	ND
AROCHLOR-1016	236.0	ND
AROCHLOR-1248	236.0	ND
AROCHLOR-1254	472.0	ND
AROCHLOR-1260	472.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 88%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

S & MOORE, INC.
701 BORMAN DRIVE
LOUIS, MO 63149
N: DAVID PURINGTON

REPORT: 2371.02B

DATE: 05-03-90

MPLE MATRIX: SOIL
D # 2371.02
HOD REF.: SW846-8270, EPA METHODOLOGY
OJECT: EARTH CITY
PLE ID: S4

DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

MIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)		SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	
NOL	660	ND		ACENAPHTHENE	660	ND	
S(2-CHLOROETHYL)ETHER	660	ND		2,4-DINITROPHENOL	3200	ND	
HLOROPHENOL	660	ND		4-NITROPHENOL	3200	ND	
-DICHLOROBENZENE	660	ND		DIBENZOFURAN	660	ND	
4-DICHLOROBENZENE	660	ND		2,4-DINITROTOLUENE	660	ND	
IZYL ALCOHOL	660	ND		2,6-DINITROTOLUENE	660	ND	
-DICHLOROBENZENE	660	ND		DIETHYLPHTHALATE	660	65	J
ETHYLPHENOL	660	ND		4-CHLOROPHENYL-PHENYLETHER	660	ND	
S(2-CHLOROISOPROPYL)ETHER	660	ND		FLUORENE	660	ND	
METHYLPHENOL	660	ND		4-NITROANILINE	3200	ND	
ITROSO-DI-n-PROPYLAMINE	660	ND		4,6-DINITRO-2-METHYLPHENOL	3200	ND	
EXACHLOROETHANE	660	ND		N-NITROSODIPHENYLAMINE(1)	660	ND	
ROBENZENE	660	ND		4-BROMOPHENYL-PHENYLETHER	660	ND	
PHORONE	660	ND		HEXACHLOROBENZENE	660	ND	
NITROPHENOL	660	ND		PENTACHLOROPHENOL	660	ND	
4-DIMETHYLPHENOL	660	ND		PHENANTHRENE	660	40	J
NZOIC ACID	3200	140	J	ANTHRACENE	660	ND	
(2-CHLOROETHOXY)METHANE	660	ND		DI-N-BUTYLPHTHALATE	660	100	J
,4-DICHLOROPHENOL	660	ND		FLUORANTHENE	660	ND	
2,4-TRICHLOROBENZENE	660	ND		PYRENE	660	30	J
PHTHALENE	660	ND		BUTYLBENZYLPHTHALATE	660	50	J
CHLOROANILINE	660	ND		3,3-DICHLOROBENZIDINE	1320	ND	
EXACHLOROBUTADIENE	660	ND		BENZO(A)ANTHRACENE	660	ND	
CHLORO-3-METHYLPHENOL	660	ND		BIS(2-ETHYLHEXYL)PHTHALATE	660	190	J
METHYLNAPHTHALENE	660	ND		CHRYSENE	660	ND	
EXACHLOROCYCLOPENTADIENE	660	ND		DI-N-OCTYL PHTHALATE	660	ND	
4,6-TRICHLOROPHENOL	660	ND		BENZO(B)FLUORANTHENE	660	ND	
4,5-TRICHLOROPHENOL	3200	ND		BENZO(K)FLUORANTHENE	660	ND	
-CHLORONAPHTHALENE	660	ND		BENZO(A)PYRENE	660	ND	
NITROANILINE	3200	ND		INDENO(1,2,3-CD)PYRENE	660	ND	
METHYLPHTHALATE	660	ND		DIBENZ(A,H)ANTHRACENE	660	ND	
ENAPHTHYLENE	660	ND		BENZO(G,H,I)PERYLENE	660	ND	
3-NITROANILINE	3200	ND					

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(23-120)	83%	2-FLUOROBIPHENYL	(30-115)	88%	TERPHENYL-d14	(18-137)	86%
HENOL-d5	(24-113)	96%	2-FLUOROPHENOL	(25-121)	80%	2,4,6-TRIBROMOPHENOL	(19-122)	103%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE
ST. LOUIS, MISSOURI 63149
ATTN: DAVE PURINGTON

REPORT: 2371.03MT

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.03
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: S3

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDES	1.0	ug/Kg	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	2.0	mg/kg	2.12	04-25-90	SW 7060
LEAD	0.6	mg/kg	12.4	04-19-90	SW 7421
MERCURY	0.1	mg/kg	ND	04-18-90	SW 7471
SELENIUM	0.4	mg/kg	ND	04-24-90	SW 7740
THALLIUM	0.4	mg/kg	ND	04-19-90	SW 7841
ANTIMONY	6.0	mg/kg	ND	04-19-90	SW 6010
BERYLLIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CADMIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CHROMIUM	1.0	mg/kg	5.5	04-19-90	SW 6010
COPPER	2.0	mg/kg	15.2	04-19-90	SW 6010
NICKEL	2.0	mg/kg	9.7	04-19-90	SW 6010
SILVER	2.0	mg/kg	ND	04-19-90	SW 6010
ZINC	2.0	mg/kg	32.8	04-19-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION #SW846, THIRD EDITION, NOVEMBER 1986
SM = STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 16TH EDITION, 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.03T

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.03
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: S3

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE EXTRACTED	DATE ANALYZED	METHOD REFERENCE
TOTAL EXTRACTABLE HYDROCARBONS						
GASOLINE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
DIESEL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
KEROSENE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
JP-4	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
NAPTHA	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
BUNKER C/#6 FUEL OIL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
MISCELLANEOUS (1)	1.0	mg/Kg	12.0	04-19-90	04-21-90	GC/FID

QA/QC SURROGATE RECOVERY

NAPHTHALENE 100%

(1) = ANALYSIS SHOWS MISCELLANEOUS PEAKS WHICH CANNOT BE IDENTIFIED AS ANY SPECIFIC PATTERN. THE RESPONSE FACTOR FOR DIESEL WAS USED.
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = COMPOUND FOUND IN BLANK AS WELL AS SAMPLE
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.03H

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.03
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: S3

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

ERBICIDES	DET. LIMIT	UNIT	RESULTS
,4-D	80.0	ug/Kg	ND
,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 91.9%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.03P

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.03
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: S3

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	19.0	ND
BETA-BHC	19.0	ND
GAMMA-BHC(LINDANE)	19.0	ND
DELTA-BHC	19.0	ND
HEPTACHLOR	19.0	ND
ALDRIN	19.0	ND
HEPTACHLOR EPOXIDE	19.0	ND
ENDOSULFAN I	19.0	ND
4,4-DDE	19.0	ND
DIELDRIN	38.0	ND
ENDRIN	38.0	ND
ENDOSULFAN II	38.0	ND
4,4-DDD	38.0	ND
ENDOSULFAN SULFATE	38.0	ND
4,4-DDT	38.0	ND
ENDRIN KETONE	38.0	ND
METHOXYCHLOR	190.2	ND
ALPHA-CHLORDANE	190.2	ND
GAMMA-CHLORDANE	190.2	ND
TOXAPHENE	380.5	ND
AROCHLOR-1221	190.2	ND
AROCHLOR-1232	190.2	ND
AROCHLOR-1242	190.2	ND
AROCHLOR-1016	190.2	ND
AROCHLOR-1248	190.2	ND
AROCHLOR-1254	380.5	ND
AROCHLOR-1260	380.5	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 81%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ES & MOORE, INC.
701 BORMAN DRIVE
. LOUIS, MO 63149
N: DAVID PURINGTON

REPORT: 2371.03B

DATE: 05-03-90

MPLE MATRIX: SOIL
O # 2371.03
THOD REF.: SW846-8270, EPA METHODOLOGY
OJECT: EARTH CITY
MPLE ID: S3

DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

MIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)		SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	
INOL	660	ND		ACENAPHTHENE	660	ND	
S(2-CHLOROETHYL)ETHER	660	ND		2,4-DINITROPHENOL	3200	ND	
CHLOROPHENOL	660	ND		4-NITROPHENOL	3200	ND	
3-DICHLOROBENZENE	660	ND		DIBENZOFURAN	660	ND	
4-DICHLOROBENZENE	660	ND		2,4-DINITROTOLUENE	660	ND	
NZYL ALCOHOL	660	ND		2,6-DINITROTOLUENE	660	ND	
2-DICHLOROBENZENE	660	ND		DIETHYLPHTHALATE	660	ND	
METHYLPHENOL	660	ND		4-CHLOROPHENYL-PHENYLETHER	660	ND	
S(2-CHLOROISOPROPYL)ETHER	660	ND		FLUORENE	660	ND	
METHYLPHENOL	660	ND		4-NITROANILINE	3200	ND	
NITROSO-DI-n-PROPYLAMINE	660	ND		4,6-DINITRO 2-METHYLPHENOL	3200	ND	
XACHLOROETHANE	660	ND		N-NITROSODIPHENYLAMINE(1)	660	ND	
TROBENZENE	660	ND		4-BROMOPHENYL-PHENYLETHER	660	ND	
OPHORONE	660	ND		HEXACHLOROBENZENE	660	ND	
NITROPHENOL	660	ND		PENTACHLOROPHENOL	660	ND	
4-DIMETHYLPHENOL	660	ND		PHENANTHRENE	660	30	J
NZOIC ACID	3200	33	J	ANTHRACENE	660	ND	
S(2-CHLOROETHOXY)METHANE	660	ND		DI-N-BUTYLPHTHALATE	660	10	J
4-DICHLOROPHENOL	660	ND		FLUORANTHENE	660	40	J
2,4-TRICHLOROBENZENE	660	ND		PYRENE	660	50	J
PHTHALENE	660	ND		BUTYLBENZYLPHTHALATE	660	ND	
CHLOROANILINE	660	ND		3,3-DICHLOROBENZIDINE	1320	ND	
XACHLOROBUTADIENE	660	ND		BENZO(A)ANTHRACENE	660	ND	
CHLORO-3-METHYLPHENOL	660	ND		BIS(2-ETHYLHEXYL)PHTHALATE	660	ND	
METHYLNAPHTHALENE	660	ND		CHRYSENE	660	ND	
XACHLOROCYCLOPENTADIENE	660	ND		DI-N-OCTYL PHTHALATE	660	ND	
4,6-TRICHLOROPHENOL	660	ND		BENZO(B)FLUORANTHENE	660	ND	
4,5-TRICHLOROPHENOL	3200	ND		BENZO(K)FLUORANTHENE	660	ND	
CHLORONAPHTHALENE	660	ND		BENZO(A)PYRENE	660	ND	
NITROANILINE	3200	ND		INDENO(1,2,3-CD)PYRENE	660	ND	
METHYLPHTHALATE	660	ND		DIBENZ(A,H)ANTHRACENE	660	ND	
ENAPHTHYLENE	660	ND		BENZO(G,H,I)PERYLENE	660	ND	
NITROANILINE	3200	ND					

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(23-120)	70%	2-FLUOROBIPHENYL(30-115)	71%	TERPHENYL-d14	(18-137)	90%
ENOL-d5	(24-113)	83%	2-FLUOROPHENOL (25-121)	67%	2,4,6-TRIBROMOPHENOL	(19-122)	79%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE
ST. LOUIS, MISSOURI 63149
ATTN: DAVE PURINGTON

REPORT: 2371.04MT

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.04
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: COMP. 2

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDES	1.0	ug/Kg	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	2.0	mg/kg	7.41	04-25-90	SW 7060
LEAD	0.6	mg/kg	15.9	04-19-90	SW 7421
MERCURY	0.1	mg/kg	ND	04-18-90	SW 7471
SELENIUM	0.4	mg/kg	ND	04-24-90	SW 7740
THALLIUM	0.4	mg/kg	ND	04-19-90	SW 7841
ANTIMONY	6.0	mg/kg	7.4	04-19-90	SW 6010
BERYLLIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CADMIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CHROMIUM	1.0	mg/kg	15.5	04-19-90	SW 6010
COPPER	2.0	mg/kg	25.0	04-19-90	SW 6010
NICKEL	2.0	mg/kg	19.2	04-19-90	SW 6010
SILVER	2.0	mg/kg	ND	04-19-90	SW 6010
ZINC	2.0	mg/kg	57.4	04-19-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION #SW846, THIRD EDITION, NOVEMBER 1986
SM = STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 16TH EDITION, 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.04T

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.04
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: COMP. 2

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE EXTRACTED	DATE ANALYZED	METHOD REFERENCE
TOTAL EXTRACTABLE HYDROCARBONS						
GASOLINE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
DIESEL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
KEROSENE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
JP-4	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
NAPTHA	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
BUNKER C/#6 FUEL OIL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
MISCELLANEOUS (1)	1.0	mg/Kg	5.1	04-19-90	04-21-90	GC/FID

QA/QC SURROGATE RECOVERY

NAPHTHALENE 95%

(1) = ANALYSIS SHOWS MISCELLANEOUS PEAKS WHICH CANNOT BE IDENTIFIED AS ANY SPECIFIC PATTERN. THE RESPONSE FACTOR FOR DIESEL WAS USED.
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = COMPOUND FOUND IN BLANK AS WELL AS SAMPLE
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.04H

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.04
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: COMP. 2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

HERBICIDES	DET. LIMIT	UNIT	RESULTS
2,4-D	80.0	ug/Kg	ND
2,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 78.2%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.04P

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.04
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: COMP. 2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	21.7	ND
BETA-BHC	21.7	ND
GAMMA-BHC(LINDANE)	21.7	ND
DELTA-BHC	21.7	ND
HEPTACHLOR	21.7	ND
ALDRIN	21.7	ND
HEPTACHLOR EPOXIDE	21.7	ND
ENDOSULFAN I	21.7	ND
4,4-DDE	21.7	ND
DIELDRIN	43.4	ND
ENDRIN	43.4	ND
ENDOSULFAN II	43.4	ND
4,4-DDD	43.4	ND
ENDOSULFAN SULFATE	43.4	ND
4,4-DDT	43.4	ND
ENDRIN KETONE	43.4	ND
METHOXYCHLOR	217.1	ND
ALPHA-CHLORDANE	217.1	ND
GAMMA-CHLORDANE	217.1	ND
TOXAPHENE	434.2	ND
AROCHLOR-1221	217.1	ND
AROCHLOR-1232	217.1	ND
AROCHLOR-1242	217.1	ND
AROCHLOR-1016	217.1	ND
AROCHLOR-1248	217.1	ND
AROCHLOR-1254	434.2	ND
AROCHLOR-1260	434.2	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 79%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

S & MOORE, INC.
1 BORMAN DRIVE
LOUIS, MO 63149
N: DAVID PURINGTON

REPORT: 2371.04B

DATE: 05-03-90

PLE MATRIX: SOIL
O # 2371.04
OD REF.: SW846-8270, EPA METHODOLOGY
ECT: EARTH CITY
MPLE ID: COMP. 2

DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

MIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)		SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	
NOL	660	ND		ACENAPHTHENE	660	ND	
(2-CHLOROETHYL)ETHER	660	ND		2,4-DINITROPHENOL	3200	ND	
HLOROPHENOL	660	ND		4-NITROPHENOL	3200	ND	
-DICHLOROBENZENE	660	ND		DIBENZOFURAN	660	ND	
-DICHLOROBENZENE	660	ND		2,4-DINITROTOLUENE	660	ND	
NZYL ALCOHOL	660	ND		2,6-DINITROTOLUENE	660	ND	
-DICHLOROBENZENE	660	ND		DIETHYLPHTHALATE	660	ND	
ETHYLPHENOL	660	ND		4-CHLOROPHENYL-PHENYLETHER	660	ND	
S(2-CHLOROISOPROPYL)ETHER	660	ND		FLUORENE	660	ND	
ETHYLPHENOL	660	ND		4-NITROANILINE	3200	ND	
ITROSO-DI-n-PROPYLAMINE	660	ND		4,6-DINITRO-2-METHYLPHENOL	3200	ND	
ACHLOROETHANE	660	ND		N-NITROSODIPHENYLAMINE(1)	660	ND	
TROBENZENE	660	ND		4-BROMOPHENYL-PHENYLETHER	660	ND	
PHORONE	660	ND		HEXACHLOROBENZENE	660	ND	
ITROPHENOL	660	ND		PENTACHLOROPHENOL	660	ND	
,4-DIMETHYLPHENOL	660	ND		PHENANTHRENE	660	30	J
ZOIC ACID	3200	30	J	ANTHRACENE	660	ND	
(2-CHLOROETHOXY)METHANE	660	ND		DI-N-BUTYLPHTHALATE	660	50	J
-DICHLOROPHENOL	660	ND		FLUORANTHENE	660	50	J
,4-TRICHLOROBENZENE	660	ND		PYRENE	660	30	J
HTHALENE	660	ND		BUTYLBENZYLPHTHALATE	660	ND	
HLOROANILINE	660	ND		3,3-DICHLOROBENZIDINE	1320	ND	
EXACHLOROBUTADIENE	660	ND		BENZO(A)ANTHRACENE	660	ND	
HLORO-3-METHYLPHENOL	660	ND		BIS(2-ETHYLHEXYL)PHTHALATE	660	ND	
ETHYLNAPHTHALENE	660	10	J	CHRYSENE	660	ND	
XACHLOROCYCLOPENTADIENE	660	ND		DI-N-OCTYL PHTHALATE	660	ND	
,6-TRICHLOROPHENOL	660	ND		BENZO(B)FLUORANTHENE	660	ND	
,5-TRICHLOROPHENOL	3200	ND		BENZO(K)FLUORANTHENE	660	ND	
HLORONAPHTHALENE	660	ND		BENZO(A)PYRENE	660	ND	
-NITROANILINE	3200	ND		INDENO(1,2,3-CD)PYRENE	660	ND	
ETHYLPHTHALATE	660	ND		DIBENZ(A,H)ANTHRACENE	660	ND	
NAPHTHYLENE	660	ND		BENZO(G,H,I)PERYLENE	660	ND	
-NITROANILINE	3200	ND					

QA/QC SURROGATE RECOVERIES

ROBENZENE-d5	(23-120)	74%	2-FLUOROBIPHENYL (30-115)	79%	TERPHENYL-d14	(18-137)	89%
NOL-d5	(24-113)	89%	2-FLUOROPHENOL (25-121)	70%	2,4,6-TRIBROMOPHENOL	(19-122)	91%

= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE
11701 BORMAN DRIVE
ST. LOUIS, MISSOURI 63149
ATTN: DAVE PURINGTON

REPORT: 2371.05MT

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.05
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: COMP. 1

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL CYANIDES	1.0	ug/Kg	ND	04-27-90	SM 412D
TOTAL METALS					
ARSENIC	2.0	mg/kg	5.89	04-25-90	SW 7060
LEAD	0.6	mg/kg	13.6	04-19-90	SW 7421
MERCURY	0.1	mg/kg	ND	04-18-90	SW 7471
SELENIUM	0.4	mg/kg	ND	04-24-90	SW 7740
THALLIUM	0.4	mg/kg	ND	04-19-90	SW 7841
ANTIMONY	6.0	mg/kg	ND	04-19-90	SW 6010
BERYLLIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CADMIUM	1.0	mg/kg	ND	04-19-90	SW 6010
CHROMIUM	1.0	mg/kg	18.1	04-19-90	SW 6010
COPPER	2.0	mg/kg	22.8	04-19-90	SW 6010
NICKEL	2.0	mg/kg	18.3	04-19-90	SW 6010
SILVER	2.0	mg/kg	ND	04-19-90	SW 6010
ZINC	2.0	mg/kg	62.4	04-19-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = TEST METHODS FOR EVALUATING SOLID WASTE, EPA PUBLICATION #SW846, THIRD EDITION, NOVEMBER 1986
SM = STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER, 16TH EDITION, 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.05T

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.05
DATE SUBMITTED: 04-13-90
PROJECT: EARTH CITY
SAMPLE ID: COMP. 1

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE EXTRACTED	DATE ANALYZED	METHOD REFERENCE
TOTAL EXTRACTABLE HYDROCARBONS						
GASOLINE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
DIESEL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
KEROSENE	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
JP-4	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
NAPTHA	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
BUNKER C/#6 FUEL OIL	1.0	mg/Kg	ND	04-19-90	04-21-90	GC/FID
MISCELLANEOUS (1)	1.0	mg/Kg	5.1	04-19-90	04-21-90	GC/FID

QA/QC SURROGATE RECOVERY

NAPHTHALENE 95%

(1) = ANALYSIS SHOWS MISCELLANEOUS PEAKS WHICH CANNOT BE IDENTIFIED AS ANY SPECIFIC PATTERN. THE RESPONSE FACTOR FOR DIESEL WAS USED.
ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = COMPOUND FOUND IN BLANK AS WELL AS SAMPLE
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE

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CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.05H

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.05
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: COMP. 1

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

HERBICIDES	DET. LIMIT	UNIT	RESULTS
2,4-D	80.0	ug/Kg	ND
2,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 99.4%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: 2371.05P

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # 2371.05
DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: COMP. 1

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	21.2	ND
BETA-BHC	21.2	ND
GAMMA-BHC(LINDANE)	21.2	ND
DELTA-BHC	21.2	ND
HEPTACHLOR	21.2	ND
ALDRIN	21.2	ND
HEPTACHLOR EPOXIDE	21.2	ND
ENDOSULFAN I	21.2	ND
4,4-DDE	21.2	ND
DIELDRIN	42.3	ND
ENDRIN	42.3	ND
ENDOSULFAN II	42.3	ND
4,4-DDD	42.3	ND
ENDOSULFAN SULFATE	42.3	ND
4,4-DDT	42.3	ND
ENDRIN KETONE	42.3	ND
METHOXYCHLOR	211.6	ND
ALPHA-CHLORDANE	211.6	ND
GAMMA-CHLORDANE	211.6	ND
TOXAPHENE	423.3	ND
AROCHLOR-1221	211.6	ND
AROCHLOR-1232	211.6	ND
AROCHLOR-1242	211.6	ND
AROCHLOR-1016	211.6	ND
AROCHLOR-1248	211.6	ND
AROCHLOR-1254	423.3	ND
AROCHLOR-1260	423.3	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 102%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ES & MOORE, INC.
701 BORMAN DRIVE
LOUIS, MO 63149
N: DAVID PURINGTON

REPORT: 2371.05B

DATE: 05-03-90

PLE MATRIX: SOIL
O # 2371.05
THOD REF.: SW846-8270, EPA METHODOLOGY
ROJECT: EARTH CITY
PLE ID: COMP. 1

DATE SUBMITTED: 04-13-90
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

IVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)
ENOL	660	ND	ACENAPHTHENE	660	ND
IS(2-CHLOROETHYL)ETHER	660	ND	2,4-DINITROPHENOL	3200	ND
CHLOROPHENOL	660	ND	4-NITROPHENOL	3200	ND
3-DICHLOROBENZENE	660	ND	DIBENZOFURAN	660	ND
,4-DICHLOROBENZENE	660	ND	2,4-DINITROTOLUENE	660	ND
NZYL ALCOHOL	660	ND	2,6-DINITROTOLUENE	660	ND
2-DICHLOROBENZENE	660	ND	DIETHYLPHTHALATE	660	ND
METHYLPHENOL	660	ND	4-CHLOROPHENYL-PHENYLETHER	660	ND
S(2-CHLOROISOPROPYL)ETHER	660	ND	FLUORENE	660	ND
METHYLPHENOL	660	ND	4-NITROANILINE	3200	ND
NITROSO-DI-n-PROPYLAMINE	660	ND	4,6-DINITRO 2-METHYLPHENOL	3200	ND
IEXACHLOROETHANE	660	ND	N-NITROSODIPHENYLAMINE(1)	660	ND
TROBENZENE	660	ND	4-BROMOPHENYL-PHENYLETHER	660	ND
OPHORONE	660	ND	HEXACHLOROBENZENE	660	ND
-NITROPHENOL	660	ND	PENTACHLOROPHENOL	660	ND
4-DIMETHYLPHENOL	660	ND	PHENANTHRENE	660	ND
NZOIC ACID	3200	ND	ANTHRACENE	660	ND
IS(2-CHLOROETHOXY)METHANE	660	ND	DI-N-BUTYLPHTHALATE	660	ND
2,4-DICHLOROPHENOL	660	ND	FLUORANTHENE	660	30 J
2,4-TRICHLOROBENZENE	660	ND	PYRENE	660	30 J
PHTHALENE	660	ND	BUTYLBENZYLPHTHALATE	660	ND
4-CHLOROANILINE	660	ND	3,3-DICHLOROBENZIDINE	1320	ND
XACHLOROBUTADIENE	660	ND	BENZO(A)ANTHRACENE	660	ND
CHLORO-3-METHYLPHENOL	660	ND	BIS(2-ETHYLHEXYL)PHTHALATE	660	ND
-METHYLNAPHTHALENE	660	ND	CHRYSENE	660	ND
EXACHLOROCYCLOPENTADIENE	660	ND	DI-N-OCTYL PHTHALATE	660	ND
4,6-TRICHLOROPHENOL	660	ND	BENZO(B)FLUORANTHENE	660	ND
,4,5-TRICHLOROPHENOL	3200	ND	BENZO(K)FLUORANTHENE	660	ND
2-CHLORONAPHTHALENE	660	ND	BENZO(A)PYRENE	660	ND
-NITROANILINE	3200	ND	INDENO(1,2,3-CD)PYRENE	660	ND
METHYLPHTHALATE	660	ND	DIBENZ(A,H)ANTHRACENE	660	ND
ACENAPHTHYLENE	660	ND	BENZO(G,H,I)PERYLENE	660	ND
-NITROANILINE	3200	ND			

QA/QC SURROGATE RECOVERIES

ITROBENZENE-d5(23-120)	72%	2-FLUOROBIPHENYL(30-115)	78%	TERPHENYL-d14 (18-137)	84%
PHENOL-d5 (24-113)	84%	2-FLUOROPHENOL (25-121)	67%	2,4,6-TRIBROMOPHENOL(19-122)	89%

D = NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ANALYTICAL REPORT

DAMES & MOORE
11701 Borman Drive
St. Louis. Missouri 63149

REPORT: G2698

REPORT DATE: 04/30/90

SWLO IDENTIFICATION

SAMPLE NO.: 2371.01 - 2371.05
DATE RECEIVED: 04/13/90

QA/QC

DESCRIPTION	PARAMETER	RESULTS	
METHOD BLANK 04/19/90	ANTIMONY	<6	mg/Kg
METHOD BLANK 04/19/90	BERYLLIUM	<1	mg/Kg
METHOD BLANK 04/19/90	CADMIUM	<1	mg/Kg
METHOD BLANK 04/19/90	CHROMIUM	<1	mg/Kg
METHOD BLANK 04/19/90	COPPER	<2	mg/Kg
METHOD BLANK 04/19/90	NICKEL	<2	mg/Kg
METHOD BLANK 04/19/90	SILVER	<2	mg/Kg
METHOD BLANK 04/19/90	ZINC	<2	mg/Kg

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: G2698.2

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # METHOD BLANK
DATE EXTRACTED: 04-27-90
DATE ANALYZED: 05-02-90
PROJECT: EARTH CITY
METHOD REFERENCE: SW846-8150, EPA METHODOLOGY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/Kg OR Parts Per Billion

HERBICIDES	DET. LIMIT	UNIT	RESULTS
2,4-D	80.0	ug/Kg	ND
2,4,5-TP (SILVEX)	10.0	ug/Kg	ND

QA/QC SURROGATE RECOVERY

2,4,5-T (10-98) 45.2%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: DAMES & MOORE, INC.
11701 BORMAN DRIVE
ST. LOUIS, MO 63149
ATTN: DAVID PURINGTON

REPORT: G2698.3

DATE: 05-03-90

SAMPLE MATRIX: SOIL
SWLO # METHOD BLANK
DATE EXTRACTED: 04-17-90
DATE ANALYZED : 05-02-90
METHOD REFERENCE: SW846-8080, EPA METHODOLOGY
PROJECT: EARTH CITY
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

PESTICIDES/PCB'S	DETECTION LIMIT	RESULTS
ALPHA-BHC	16.0	ND
BETA-BHC	16.0	ND
GAMMA-BHC(LINDANE)	16.0	ND
DELTA-BHC	16.0	ND
HEPTACHLOR	16.0	ND
ALDRIN	16.0	ND
HEPTACHLOR EPOXIDE	16.0	ND
ENDOSULFAN I	16.0	ND
4,4-DDE	16.0	ND
DIELDRIN	32.0	ND
ENDRIN	32.0	ND
ENDOSULFAN II	32.0	ND
4,4-DDD	32.0	ND
ENDOSULFAN SULFATE	32.0	ND
4,4-DDT	32.0	ND
ENDRIN KETONE	32.0	ND
METHOXYCHLOR	160.0	ND
ALPHA-CHLORDANE	160.0	ND
GAMMA-CHLORDANE	160.0	ND
TOXAPHENE	320.0	ND
AROCHLOR-1221	160.0	ND
AROCHLOR-1232	160.0	ND
AROCHLOR-1242	160.0	ND
AROCHLOR-1016	160.0	ND
AROCHLOR-1248	160.0	ND
AROCHLOR-1254	320.0	ND
AROCHLOR-1260	320.0	ND

QA/QC SURROGATE RECOVERIES

DIBUTYLCHLORENDATE (24-150) 24%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

MES & MOORE, INC.
701 BORMAN DRIVE
. LOUIS, MO 63149
TN: DAVID PURINGTON

REPORT: G2698.4

DATE: 05-03-90

MPLE MATRIX: SOIL
LO # METHOD BLANK
THOD REF.: SW846-8270, EPA METHODOLOGY
OJECT: EARTH CITY
MPLE ID: METHOD BLANK

DATE EXTRACTED: 04-17-90
DATE ANALYZED : 04-26-90

MIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)	SEMIVOLATILES	DET. LIMIT	RESULTS (ug/Kg)
ENOL	660	ND	ACENAPHTHENE	660	ND
S(2-CHLOROETHYL)ETHER	660	ND	2,4-DINITROPHENOL	3200	ND
CHLOROPHENOL	660	ND	4-NITROPHENOL	3200	ND
3-DICHLOROBENZENE	660	ND	DIBENZOFURAN	660	ND
4-DICHLOROBENZENE	660	ND	2,4-DINITROTOLUENE	660	ND
NZYL ALCOHOL	660	ND	2,6-DINITROTOLUENE	660	ND
2-DICHLOROBENZENE	660	ND	DIETHYLPHTHALATE	660	ND
METHYLPHENOL	660	ND	4-CHLOROPHENYL-PHENYLETHER	660	ND
S(2-CHLOROISOPROPYL)ETHER	660	ND	FLUORENE	660	ND
METHYLPHENOL	660	ND	4-NITROANILINE	3200	ND
NITROSO-DI-n-PROPYLAMINE	660	ND	4,6-DINITRO 2-METHYLPHENOL	3200	ND
XACHLOROETHANE	660	ND	N-NITROSODIPHENYLAMINE(1)	660	ND
TROBENZENE	660	ND	4-BROMOPHENYL-PHENYLETHER	660	ND
OPHORONE	660	ND	HEXACHLOROBENZENE	660	ND
NITROPHENOL	660	ND	PENTACHLOROPHENOL	660	ND
4-DIMETHYLPHENOL	660	ND	PHENANTHRENE	660	ND
NZOIC ACID	3200	ND	ANTHRACENE	660	ND
S(2-CHLOROETHOXY)METHANE	660	ND	DI-N-BUTYLPHTHALATE	660	ND
4-DICHLOROPHENOL	660	ND	FLUORANTHENE	660	ND
2,4-TRICHLOROBENZENE	660	ND	PYRENE	660	ND
PHTHALENE	660	ND	BUTYLBENZYLPHTHALATE	660	ND
CHLOROANILINE	660	ND	3,3-DICHLOROBENZIDINE	1320	ND
EXACHLOROBUTADIENE	660	ND	BENZO(A)ANTHRACENE	660	ND
CHLORO-3-METHYLPHENOL	660	ND	BIS(2-ETHYLHEXYL)PHTHALATE	660	ND
METHYLNAPHTHALENE	660	ND	CHRYSENE	660	ND
XACHLOROCYCLOPENTADIENE	660	ND	DI-N-OCTYL PHTHALATE	660	ND
4,6-TRICHLOROPHENOL	660	ND	BENZO(B)FLUORANTHENE	660	ND
4,5-TRICHLOROPHENOL	3200	ND	BENZO(K)FLUORANTHENE	660	ND
CHLORONAPHTHALENE	660	ND	BENZO(A)PYRENE	660	ND
-NITROANILINE	3200	ND	INDENO(1,2,3-CD)PYRENE	660	ND
METHYLPHTHALATE	660	ND	DIBENZ(A,H)ANTHRACENE	660	ND
ENAPHTHYLENE	660	ND	BENZO(G,H,I)PERYLENE	660	ND
NITROANILINE	3200	ND			

QA/QC SURROGATE RECOVERIES

TROBENZENE-d5	(23-120)	65%	2-FLUOROBIPHENYL	(30-115)	64%	TERPHENYL-d14	(18-137)	65%
NOL-d5	(24-113)	76%	2-FLUOROPHENOL	(25-121)	62%	2,4,6-TRIBROMOPHENOL	(19-122)	68%

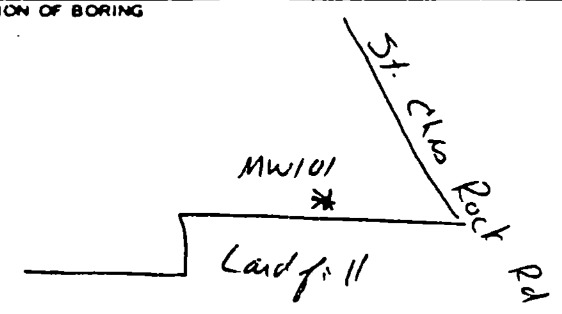
= NOT DETECTED ABOVE QUANTITATION LIMIT
= ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

APPENDIX D
Soil Boring Logs

Dames & Moore

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	19943-002	FORD	Earth City MO

LOCATION OF BORING



(140S/100W Gamma Grid)

DRILLING METHOD: 3 3/4" Hollow Stem Auger, ATV Mounted

SAMPLING METHOD: 3" I D Continuous Sampler, 5' Length

BORING NO. MW101

SHEET 1 OF 2

WATER LEVEL	16			
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	1:15	
DATE	4-11-90	

DATUM — ELEVATION

SURFACE CONDITIONS: Tilled Topsoil

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60/42		1 / 0-5			0		Topsoil dark brown silt
						1		Medium/fine lt/med brown sandy silt
						2		
						3		Brown silt
						4		Brown silty sand
CS	60/30		2 / 5-10			5		Brown sand Sandy silt w/ some clay
						6		Fine silty sand - lt. brown
						7		
						8		
						9		
CS	60/24		3 / 10-15			10		
						1		
						2		
						3		
						4		
CS	60/24		4 / 15-20			15		
						6	▽	Fine sand
						7		Fine/Medium sand
						8		Fine silty sand
						9		
						20		

DATE 4-11-90 CHK'D BY

628 1 (3) (REV 11-80)

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	19943.002	Ford	

DRILLING METHOD:	BORING NO.
	MW101
	SHEET 2 OF 2
SAMPLING METHOD:	DRILLING

					START	FINISH
WATER LEVEL					TIME	TIME
TIME						
DATE					DATE	DATE
CASING DEPTH						

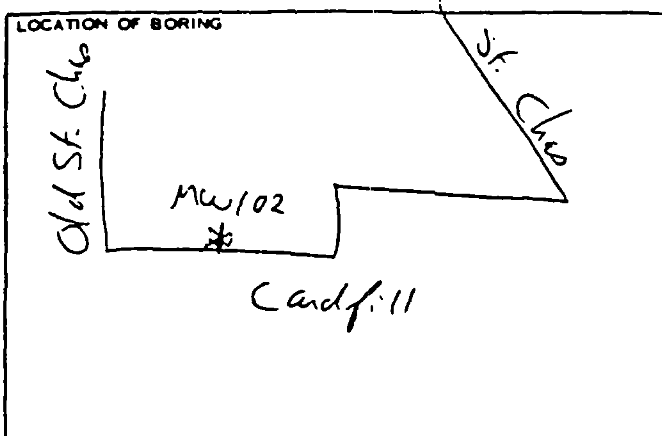
DATUM ELEVATION

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	SURFACE CONDITIONS:
CS	60 / 24		5 / 20-25			20		fine silty sand
						1		
						2		
						3		
						4		
						25	EOB 25'	
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

BY DATE 9-11-90 CHK'D BY

628.1 (3) (REV 11-80)

Dames & Moore

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	19943-002	FORD	Earth City Mo

DRILLING METHOD:	3 1/4 ID Hollow Stem Augs, ATV Mounted
BORING NO.	MW102
SAMPLING METHOD:	3" ID Continuous Sampler, 5' length
SHEET	1 OF 2

WATER LEVEL	19.5			
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	10:00	
DATE	4-11-90	

DATUM ELEVATION

SURFACE CONDITIONS: Tilled Topsoil

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60/36		1/0-5			00		dark brown silt
						1		
						2		lt brown fine sandy silt
						3		
						4		
CS	60/30		2/5-10			05		
						6		
						7		lt brown medium sand
						8		
						9		
CS	60/24		3/10-15			10		
						1		
						2		
						3		
						4		
CS	60/18		4/15-20			15		
						6		
						7		
						8		
						9		bottom 3" wet
						20		

DRILLING BY — CHK'D BY — DATE

828 (3) (REV 11-80)

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
	19943.002	FORD	

DRILLING METHOD:

SAMPLING METHOD:

BORING NO. MW102

SHEET 2 OF 2

DRILLING	
START	FINISH
TIME	TIME
DATE	DATE

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

DATUM

ELEVATION

SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	
CS	60/6					20		No retrieval
						1		
						2		
						3		
						4		
						25	EOB 25'	
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

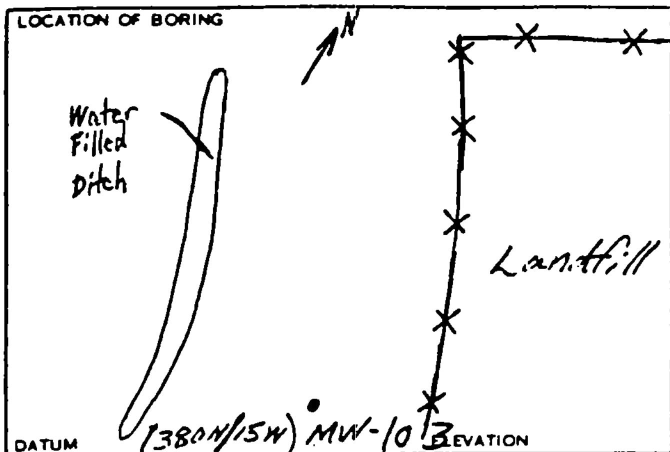
CHK'D BY

DATE 4-11-90

628 1 (3) (REV 11-80)

Dames & Moore

LOCATION OF BORING



DATUM ELEVATION

JOB NO.	CLIENT	LOCATION
19943-002	Ford	Earth City

DRILLING METHOD:	3 3/4" Hollow Stem Augers
SAMPLING METHOD:	3" I.D. Continuous Sampler
BORING NO.	MW-103
SHEET	1 OF 2

WATER LEVEL	7'			
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	11:30	
DATE	04/09	04/09

SURFACE CONDITIONS: Grassy Topsoil

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT. SAMPLER	HNU	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60" / 48"		1 / 0'			0		
					0	1	ML	Dark brown, med stiff, slightly moist clay silt, high organic content
						2		
						3		
						4		Gray, med stiff, fine silt with traces of clay
						5		
CS	60" / 60"		2 / 5'			6		
					0	7		Moist gray, med stiff to stiff, fine silt w/ traces of sand
						8		
						9		
						10		
CS	60" / 42"		3 / 10'			1	SM	Very moist, gray, fine sand with silt, very soft and runny
					0	2		
						3		
						4		
						5		
CS	36" / 36"		4 / 15'			6		
					0	7		
						8		
						9	EOB-18'	
						20		

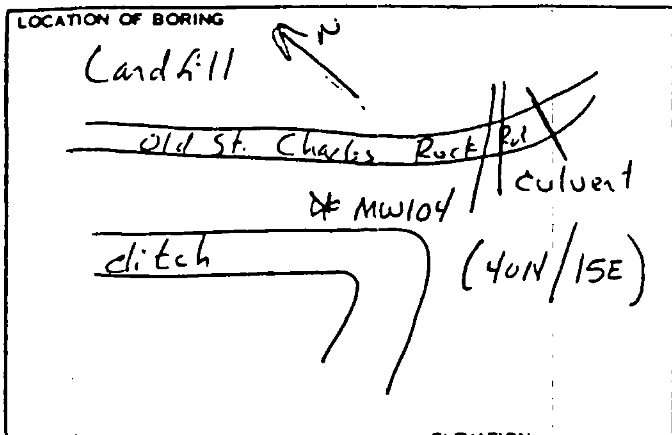
Steel Prot Casing
2.7'
2' Dia. Pad
2.5'
Bentonite Pellets
4.5'
Sand: WB-35
Well: 2" Dia PVC
Screen: #10 Slot Size PVC
Sand
(From Top of PVC)
18.4'

CME-55

DATE 04/09/9? CHK'D BY

Dames & Moore

LOCATION OF BORING	JOB NO.	CLIENT	LOCATION
(see sketch)	19943-002	FORD	Earth City, Mo



DATUM | ELEVATION

DRILLING METHOD:	3 3/4" ID Hollow Stem Auger
SAMPLING METHOD:	3" ID Continuous Sampler 5' length
WATER LEVEL	7'
TIME	
DATE	
CASING DEPTH	
BORING NO.	MW-104
SHEET	1 OF 1
DRILLING START TIME	8:20
DRILLING FINISH TIME	9:00
START DATE	4-11-90
FINISH DATE	

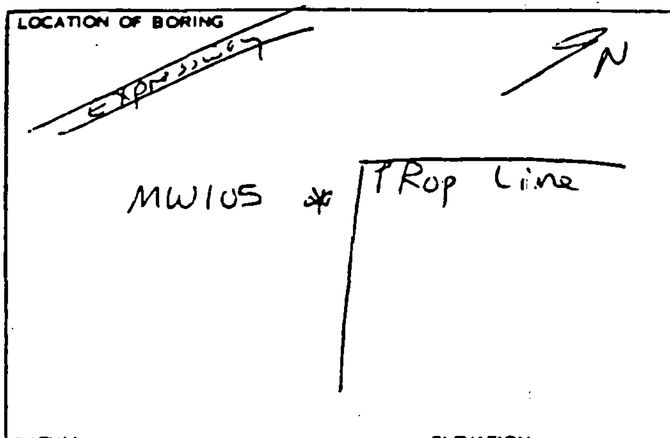
SURFACE CONDITIONS: Grassy Topsoil

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60/48		1 / 0-5			00		moist dark brown topsoil silt
						1		sandy silt
						2		Medium to light brown stiff fine silt
						3		
						4		Medium brown to gray silt w/ black and rust particles
CS	60/48		2 / 5-10			05		
						6		Medium brown stiff silty clay
						7		
						8		Medium brown fine silt w/ rust stains
						9		stiff medium brown stiff silt
CS	60/12		3 / 10-15			10		dark gray fine sand
						1		
						2		
						3		
						4		
CS	24/30		4 / 15-17			15		
						6		
						17	EOB 17'	
						8		
						9		
						0		

BY | DATE 4-12-90 | CHK'D BY

628 1 (3) (REV 11-80)

LOCATION OF BORING



JOB NO.	CLIENT	LOCATION
19943.002	FORD	Earth City MO

DRILLING METHOD: 3 1/4" ID Hollow Stem Auger - ATV Mounted

SAMPLING METHOD: 3" ID Continuous Sampler 5' Length

BORING NO. MW-105

SHEET 1 OF 1

WATER LEVEL	3 1/2			
TIME				
DATE				
CASING DEPTH				

DRILLING

START TIME	FINISH TIME
8:50	9:15
DATE	**DATE**
4-12-90	

DATUM ELEVATION

SURFACE CONDITIONS: wooded, light brush cover, leaves & decaying matter

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60/48		1 / 0-5			00		stiff dark brown silt/clay organic
						1		mixed dark and light brown silt
						2		
						3		fine silty clay
						4	▽	wet sandy silt, medium brown w/ dk brown material
CS	60/42		2 / 5-10			05		fine sandy silt; brown/gray fine sandy silt w/ rust
						6		
						7		gray silty clay; gray fine sand
						8		
						9		fine brown sand
CS	60/15		3 / 10-15			10		medium to light brown
						1		
						2		
						3		
						4		
						15	EOB 15'	
						6		
						7		
						8		
						9		
						0		

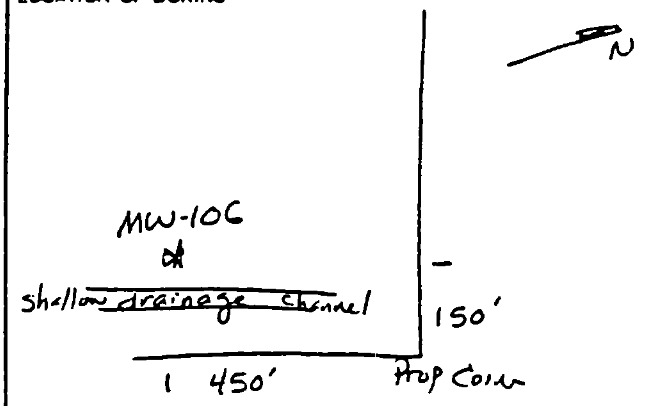
CHK'D BY

DATE 4-12-90

628 1 (3) (REV. 11-80)

JOB NO.	CLIENT	LOCATION
19943-002	FORD	Earth City MO

LOCATION OF BORING



DATUM

ELEVATION

DRILLING METHOD:	BORING NO.
3 3/4" I.D Hollow Stem Auger ATV mounted	MW-106

SAMPLING METHOD:	SHEET
3" ID Continuous Sampler 5' Length	1 OF 1

WATER LEVEL	9'			
TIME				
DATE				
CASING DEPTH				

DRILLING	START	FINISH
TIME	10:15	
DATE	4-12-90	

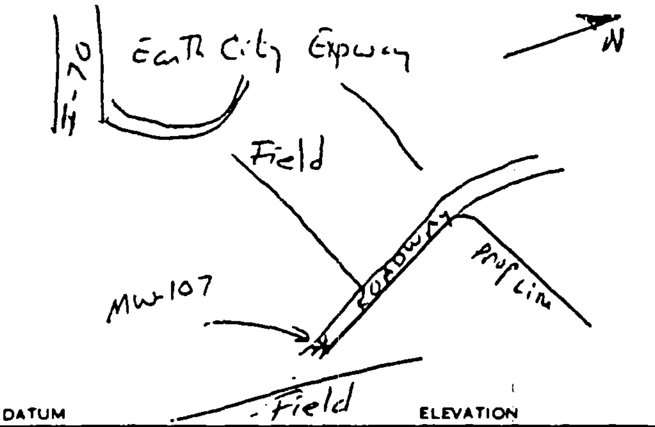
SURFACE CONDITIONS: wooded lt brush cover, leaves & decaying matter

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	
CS	60/37		1/0-5			00		dark brown clay/silt w/ organic matter medium brown fine silt w/ rust spots
						1		↓
						2		medium/dark brown fine silt ↓
						3		stiff dark brown silty/clay w/ rust ↓
						4		Medium brown silty sand
CS	60/45		2/5-10			05		dk brown silty clay w/ rust
						6		
						7		
						8		↓
						9	▽	fine silty sand, tight and moist
CS	60/48		3/10-15			10		↓
						1		very tight gray silty clay ↓
						2		brown/grey sandy silt w/ rust
						3		fine sand
						4		dk grey fine clay ↓
						15		
						6	EOB 15'	
						7		
						8		
						9		
						0		

DATE 4-12-90 CHK'D BY

628 (1/31) (REV 11-80)

LOCATION OF BORING



DATUM

ELEVATION

JOB NO.	CLIENT	LOCATION
19943.002	FORD	Earth City MO

DRILLING METHOD: 3 3/4" I.D Hollow Stem Auger, ATV mounted

SAMPLING METHOD: 3" ID Continuous Sampler, 5' Length

WATER LEVEL	5'			
TIME				
DATE				
CASING DEPTH				

BORING NO. MW-107

SHEET 1 OF 1

DRILLING	
START	FINISH
TIME 11:25	TIME 12:45
DATE 4-12-90	DATE

SURFACE CONDITIONS: Wooded lt brush cover, leaves & decaying matter

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT. SAMPLER	NUMBER OF RINGS	DEPTH IN FEET	SOIL GRAPH	DESCRIPTION
CS	60/30		1/0-5			0 0		organic matter Medium brown fine silt
						1		
						2		Med/lt brown fine silt
						3		
						4		
CS	60/60		2/5-10			0 5	▽	dark gray silty clay, stiff
						6		
						7		
						8		
						9		
CS	60/60		3/10-15			1 0		
						1		
						2		
						3		
						4		
						1 5	EOB 15'	dark gray fine sand w/ silt & clay
						6		
						7		Note: 2" diameter PVC well installed to 15'
						8		10' of #10 slot screen 11-1/2' of sand pack
						9		1-1/2' of bentonite pellets locking protective steel casing
						0		

DATE 4-12-90 CHK'D BY

628 ... (REV 11-80)

WLLFOIA4312 - 015 - 0172973

APPENDIX E
Well Construction Diagrams

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ________

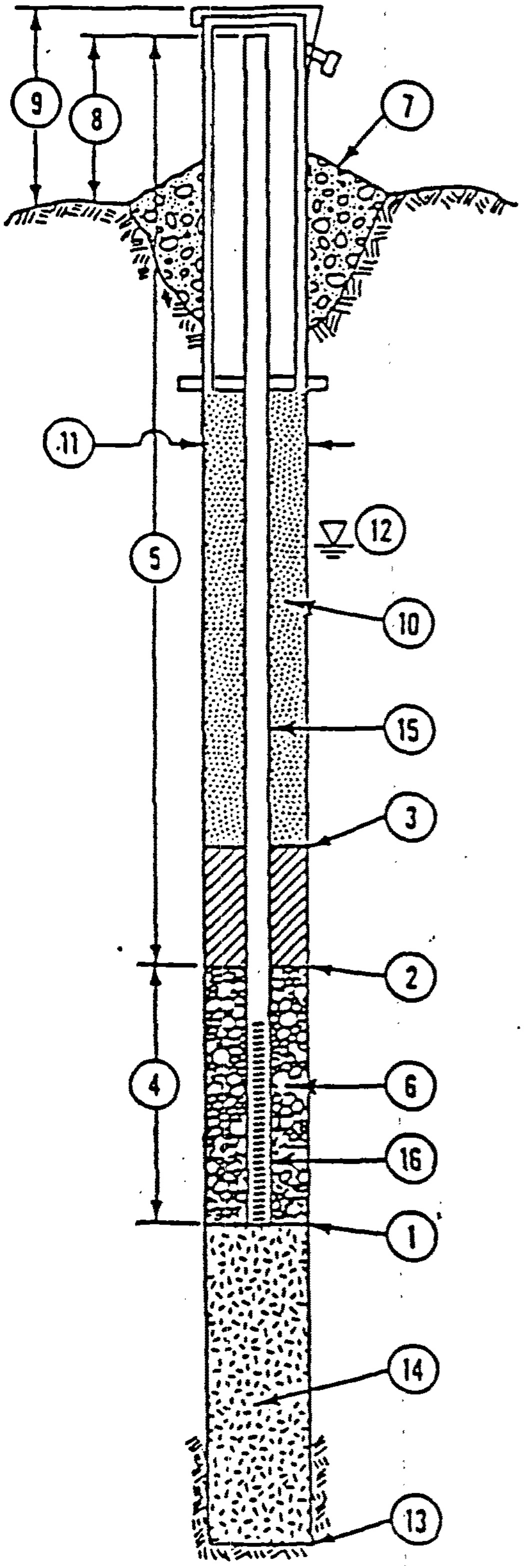
TOP OF WELL CASING ELEVATION 447.66

JOB NUMBER 19943-002

BORING NUMBER MW-101

DATE 4-11-90

LOCATION Earth City, MO



(1) DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 25 FEET.*

(2) DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 12.5 FEET.* Bentonite Pellets

(3) DEPTH TO TOP OF SEAL (IF INSTALLED) 9.5 FEET.*

(4) LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.

(5) TOTAL LENGTH OF PIPE 17.3 FEET AT 2 INCH DIAMETER.

(6) TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.

(7) CONCRETE CAP. YES NO (CIRCLE ONE)

(8) HEIGHT OF WELL CASING ABOVE GROUND 2.3 FEET.

(9) PROTECTIVE CASING? YES NO (CIRCLE ONE)
HEIGHT ABOVE GROUND ________ FEET.
LOCKING CAP? YES NO (CIRCLE ONE)

(10) TYPE OF UPPER BACKFILL cement slurry

(11) BOREHOLE DIAMETER 8 INCHES.

(12) DEPTH TO GROUND WATER 16 FEET.*

(13) TOTAL DEPTH OF BOREHOLE 25 FEET.*

(14) TYPE OF LOWER BACKFILL N/A.

(15) PIPE MATERIAL PVC.

(16) SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ____________

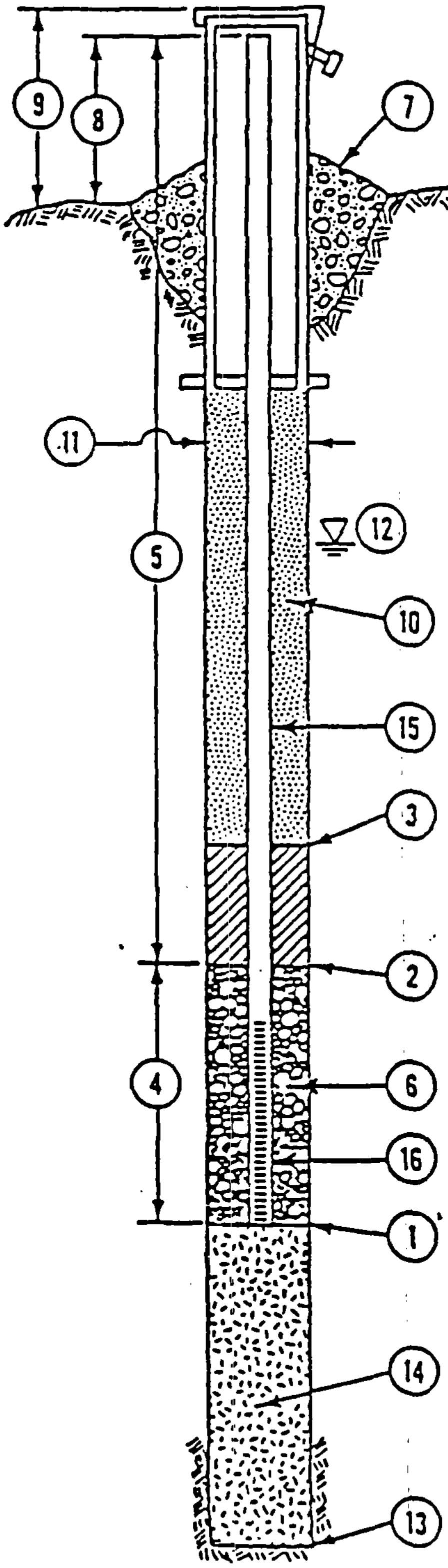
TOP OF WELL CASING ELEVATION 448.98

JOB NUMBER 19943-002

BORING NUMBER MW-102

DATE 4-11-90

LOCATION Earth City, MO



(1) DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 24.5 FEET.*

(2) DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 12 FEET.* Bentonite Pellets

(3) DEPTH TO TOP OF SEAL (IF INSTALLED) 9.5 FEET.*

(4) LENGTH OF WELL SCREEN 10 FEET.
SLOT SIZE 0.010.

(5) TOTAL LENGTH OF PIPE 16.8 FEET AT 2 INCH DIAMETER.

(6) TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.

(7) CONCRETE CAP. YES NO (CIRCLE ONE)

(8) HEIGHT OF WELL CASING ABOVE GROUND 2.3 FEET.

(9) PROTECTIVE CASING? YES NO (CIRCLE ONE)
HEIGHT ABOVE GROUND ____________ FEET.
LOCKING CAP? YES NO (CIRCLE ONE)

(10) TYPE OF UPPER BACKFILL Cement slurry

(11) BOREHOLE DIAMETER 8 INCHES.

(12) DEPTH TO GROUND WATER 20 FEET.*

(13) TOTAL DEPTH OF BOREHOLE 25 FEET.*

(14) TYPE OF LOWER BACKFILL natural sand & silt

(15) PIPE MATERIAL PVC.

(16) SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ________

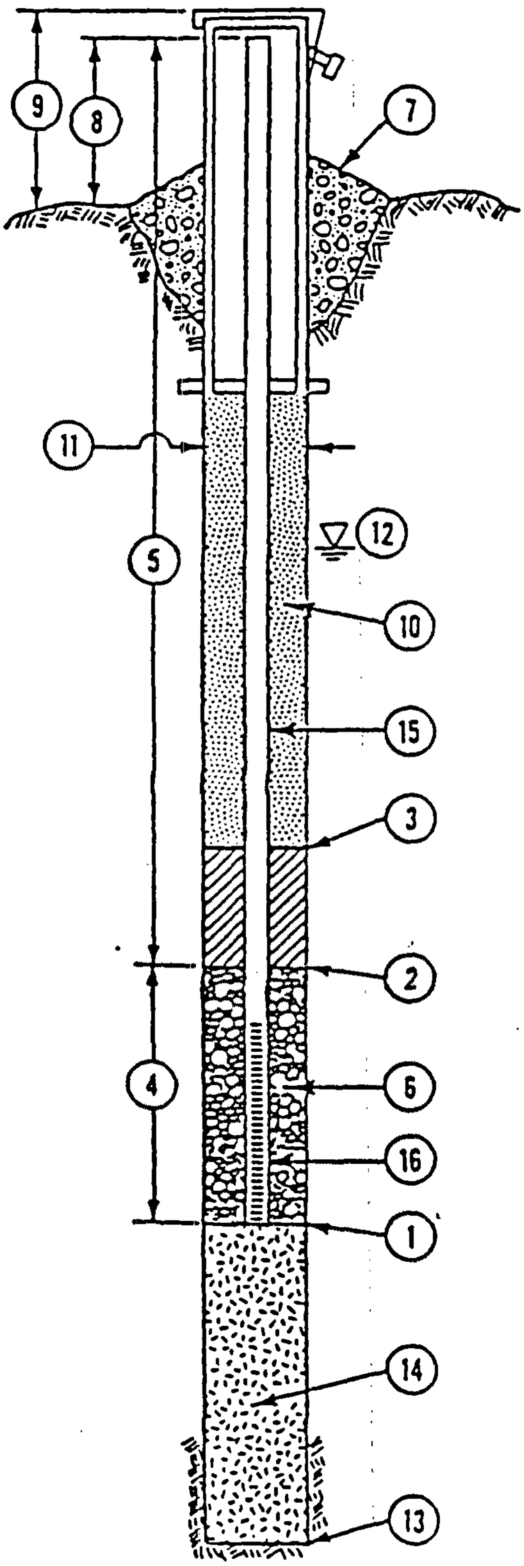
TOP OF WELL CASING ELEVATION 441.16

JOB NUMBER 17943-002

BORING NUMBER MW-103

DATE 04/09/90

LOCATION Earth City, MO



① DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 15.7 FEET.*

② DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 4.5 FEET.* Bentonite Pellets

③ DEPTH TO TOP OF SEAL (IF INSTALLED) 2.5 FEET.*

④ LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.

⑤ TOTAL LENGTH OF PIPE 8.4 FEET AT 2 INCH DIAMETER.

⑥ TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE sand.

⑦ CONCRETE CAP. YES NO (CIRCLE ONE)

⑧ HEIGHT OF WELL CASING ABOVE GROUND 2.7 FEET.

⑨ PROTECTIVE CASING? YES NO (CIRCLE ONE)
HEIGHT ABOVE GROUND 2.8 FEET.
LOCKING CAP? YES NO (CIRCLE ONE)

⑩ TYPE OF UPPER BACKFILL cement slurry

⑪ BOREHOLE DIAMETER 8 INCHES.

⑫ DEPTH TO GROUND WATER 7 FEET.*

⑬ TOTAL DEPTH OF BOREHOLE 18 FEET.*

⑭ TYPE OF LOWER BACKFILL Natural sand + silt

⑮ PIPE MATERIAL PVC.

⑯ SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ____________

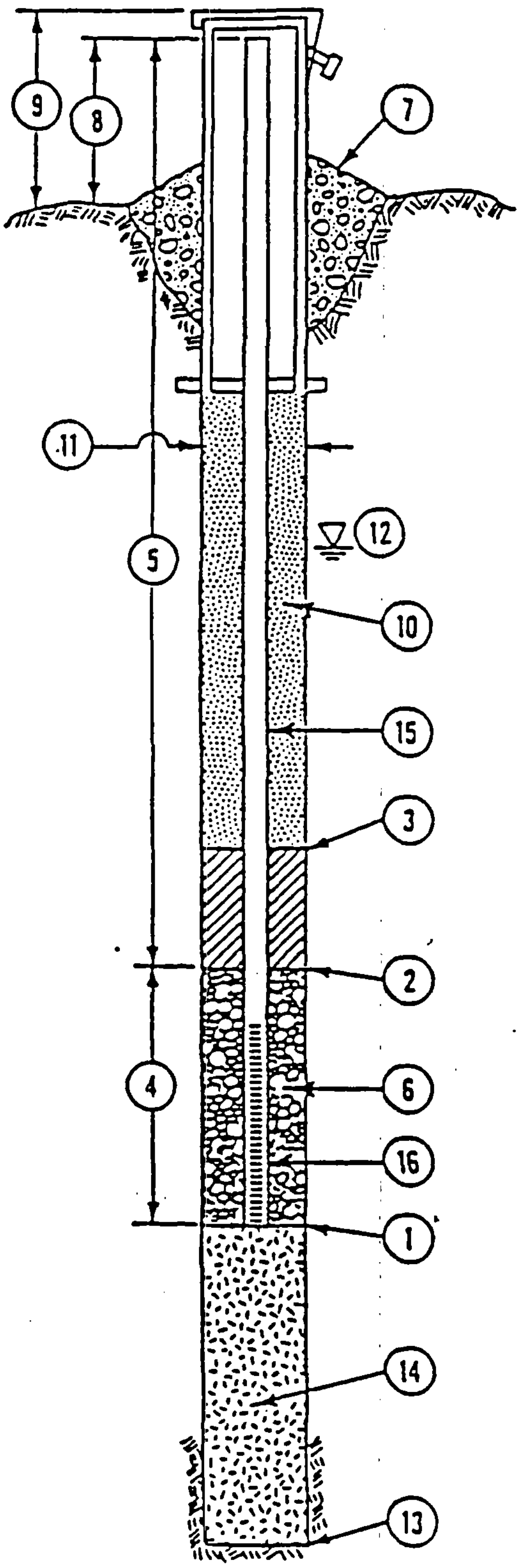
TOP OF WELL CASING ELEVATION 441.88

JOB NUMBER 19943-002

BORING NUMBER MW-104

DATE 4-11-90

LOCATION Earth City MO



1. DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 17 FEET.*
2. DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 5 FEET.* Bentonite Pellets
3. DEPTH TO TOP OF SEAL (IF INSTALLED) 2.3 FEET.*
4. LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.
5. TOTAL LENGTH OF PIPE 9.9 FEET AT 2 INCH DIAMETER.
6. TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.
7. CONCRETE CAP. YES NO (CIRCLE ONE)
8. HEIGHT OF WELL CASING ABOVE GROUND 2.9 FEET.
9. PROTECTIVE CASING? YES NO (CIRCLE ONE)
   HEIGHT ABOVE GROUND ______ FEET.
   LOCKING CAP? YES NO (CIRCLE ONE)
10. TYPE OF UPPER BACKFILL Cement.
11. BOREHOLE DIAMETER 8 INCHES.
12. DEPTH TO GROUND WATER 7 FEET.*
13. TOTAL DEPTH OF BOREHOLE 17 FEET.*
14. TYPE OF LOWER BACKFILL N/A.
15. PIPE MATERIAL PVC.
16. SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ________

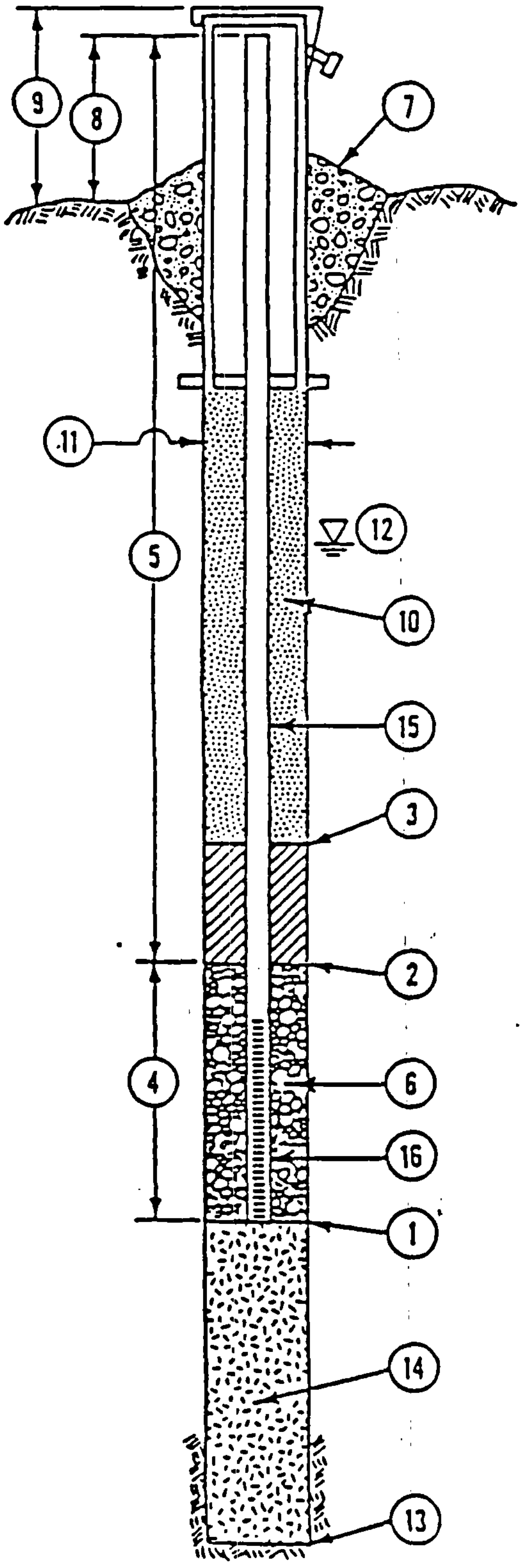
TOP OF WELL CASING ELEVATION 440.17

JOB NUMBER 19943-002

BORING NUMBER MW-105

DATE 4-12-90

LOCATION Earth City MO



(1) DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 15 FEET.*

(2) DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 3.5 FEET.* Bentonite Pellets

(3) DEPTH TO TOP OF SEAL (IF INSTALLED) 2 FEET.*

(4) LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.

(5) TOTAL LENGTH OF PIPE 23 FEET AT 2 INCH DIAMETER.

(6) TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.

(7) CONCRETE CAP. YES NO (CIRCLE ONE) — YES

(8) HEIGHT OF WELL CASING ABOVE GROUND 2.3 FEET.

(9) PROTECTIVE CASING? YES NO (CIRCLE ONE) — YES
HEIGHT ABOVE GROUND ________ FEET.
LOCKING CAP? YES NO (CIRCLE ONE) — YES

(10) TYPE OF UPPER BACKFILL Cement.

(11) BOREHOLE DIAMETER 8 INCHES.

(12) DEPTH TO GROUND WATER 3 1/2 FEET.*

(13) TOTAL DEPTH OF BOREHOLE 15 FEET.*

(14) TYPE OF LOWER BACKFILL N/A.

(15) PIPE MATERIAL PVC.

(16) SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ____________

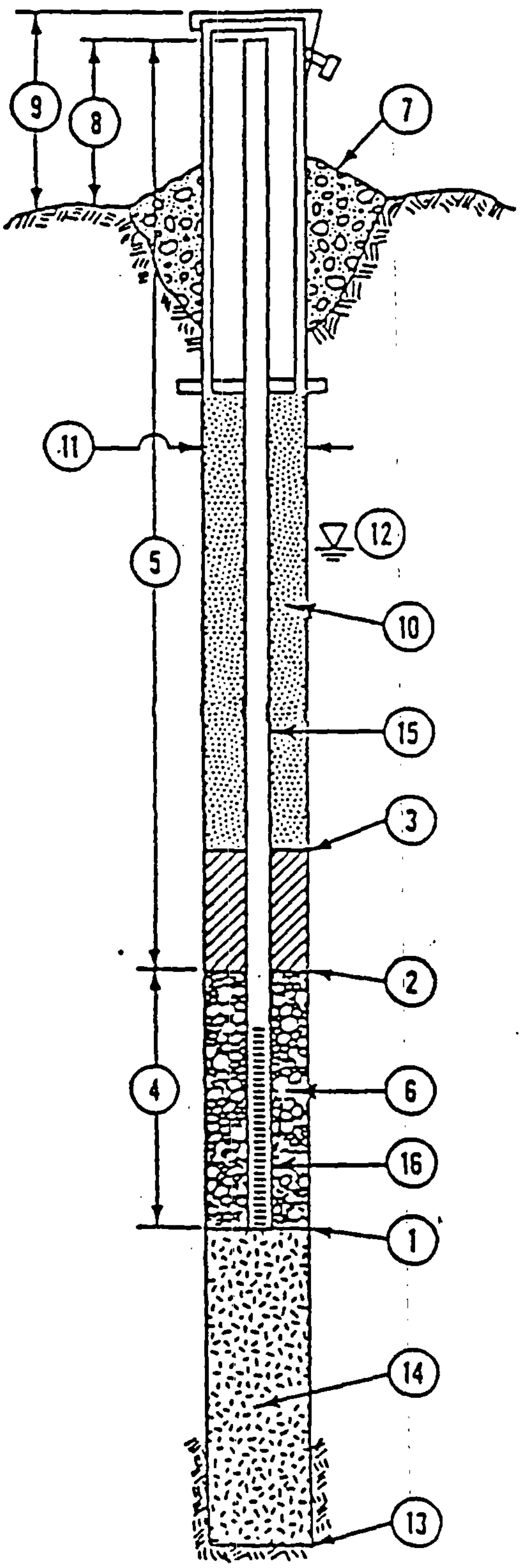
TOP OF WELL CASING ELEVATION 444.70

JOB NUMBER 19943-002

BORING NUMBER MW-106

DATE 4-12-90

LOCATION Earth City MO



1. DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 15 FEET.*
2. DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 3.5 FEET.* Bentonite Pellets
3. DEPTH TO TOP OF SEAL (IF INSTALLED) 2 FEET.*
4. LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.
5. TOTAL LENGTH OF PIPE ________ FEET AT 2 INCH DIAMETER.
6. TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.
7. CONCRETE CAP. YES NO (CIRCLE ONE)
8. HEIGHT OF WELL CASING ABOVE GROUND ________ FEET.
9. PROTECTIVE CASING? YES NO (CIRCLE ONE)
   HEIGHT ABOVE GROUND ________ FEET.
   LOCKING CAP? YES NO (CIRCLE ONE)
10. TYPE OF UPPER BACKFILL cement
11. BOREHOLE DIAMETER 8 INCHES.
12. DEPTH TO GROUND WATER 9 FEET.*
13. TOTAL DEPTH OF BOREHOLE 15 FEET.*
14. TYPE OF LOWER BACKFILL N/A.
15. PIPE MATERIAL PVC.
16. SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

MONITOR WELL INFORMATION SHEET

GROUND SURFACE ELEVATION ____________

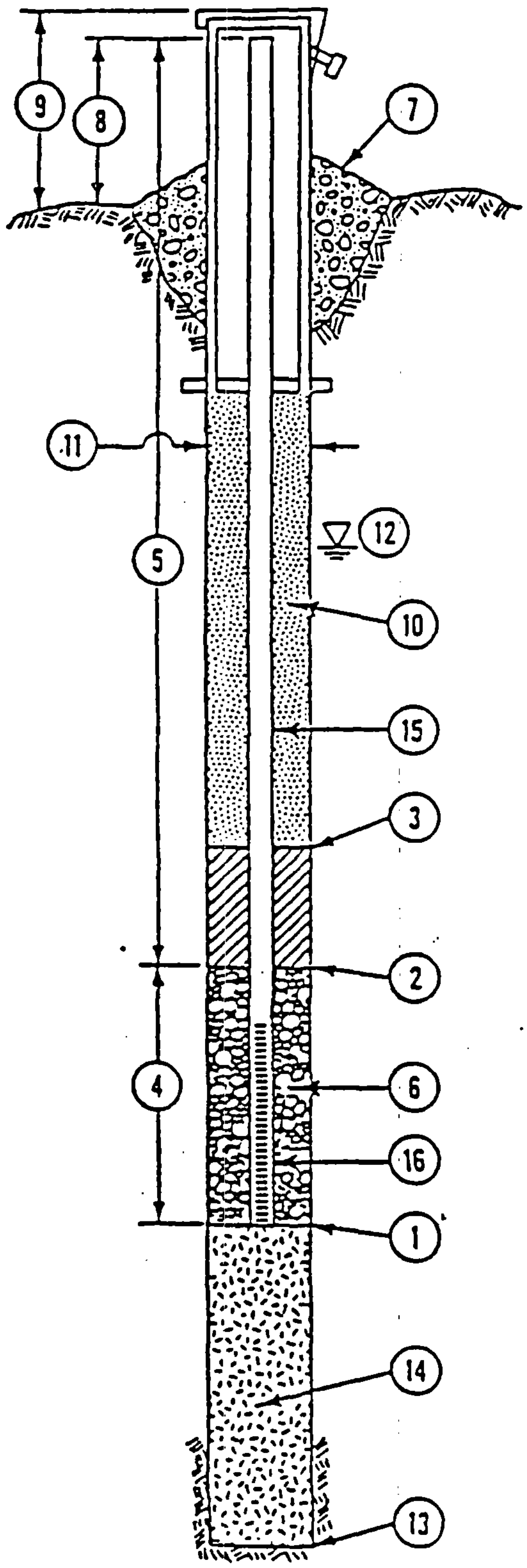
TOP OF WELL CASING ELEVATION 449.25

JOB NUMBER 19943-002

BORING NUMBER MW-107

DATE 4-12-90

LOCATION East City MO



1. DEPTH TO BOTTOM OF WELL POINT OR SLOTTED PIPE 15 FEET.*
2. DEPTH TO BOTTOM OF SEAL (IF INSTALLED) 3.5 FEET.*
3. DEPTH TO TOP OF SEAL (IF INSTALLED) 2 FEET.*
4. LENGTH OF WELL SCREEN 10 FEET. SLOT SIZE 0.010.
5. TOTAL LENGTH OF PIPE ________ FEET AT 2 INCH DIAMETER.
6. TYPE OF PACK AROUND WELL POINT OR SLOTTED PIPE SAND.
7. CONCRETE CAP. YES NO (CIRCLE ONE)
8. HEIGHT OF WELL CASING ABOVE GROUND ________ FEET.
9. PROTECTIVE CASING? YES NO (CIRCLE ONE) HEIGHT ABOVE GROUND ________ FEET. LOCKING CAP? YES NO (CIRCLE ONE)
10. TYPE OF UPPER BACKFILL Cement.
11. BOREHOLE DIAMETER 8 INCHES.
12. DEPTH TO GROUND WATER 5 FEET.*
13. TOTAL DEPTH OF BOREHOLE 15 FEET.*
14. TYPE OF LOWER BACKFILL N/A.
15. PIPE MATERIAL PVC.
16. SCREEN MATERIAL PVC.

*(DEPTH FROM GROUND SURFACE)

MONITOR WELL INSTALLATION DETAILS

Dames & Moore

APPENDIX F
Groundwater Field Measurements

MONITORING WELL FIELD DATA SHEET

Field Personnel

D. Purington

J. Peck

Job No. 19943-002

Location Earth City MO

Well No. MW-101

Date April 16, 1990

Total Well Depth (from top of casing) 27.3 feet

Depth to Water Surface (from top of casing) 18.58 feet

Height of Water Column 8.72 feet

Volume of Water Column (height x 0.163) 1.4 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	micromhos	°F	standard units
1	1067	63.9	7.04
2	712	62.3	7.06
3	711	61.8	7.05
4	714	62.0	7.07
5			
6			
7			
8			

MONITORING WELL FIELD DATA SHEET

Field Personnel

D. Purington

M. Swanson

Job No. 19943-002

Location Earth City, MO

Well No. MW-102

Date April 17, 1990

Total Well Depth (from top of casing) 26.8 feet

Depth to Water Surface (from top of casing) 20.17 feet

Height of Water Column 6.63 feet

Volume of Water Column (height x 0.163) 1.08 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	Micromhos	°F	standard units
1	956	54.9	7.20
2	942	53.3	7.27
3	959	51.2	7.26
4	956	52.1	7.25
5	965	52.7	7.20
6			
7			
8			

MONITORING WELL FIELD DATA SHEET

Field Personnel

D Purington

M. Swanson

Job No. 19943-002

Location East City MO

Well No. MW-103

Date April 17, 1990

Total Well Depth (from top of casing) 18.4 feet

Depth to Water Surface (from top of casing) 11.92 feet

Height of Water Column 6.48 feet

Volume of Water Column (height x 0.163) 1.06 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	Micromhos	°F	standard units
1	695	60.0	7.00
2	677	58.4	7.05
3	677	59.2	7.00
4			
5			
6			
7			
8			

WLLFOIA4312 - 015 - 0172985

MONITORING WELL FIELD DATA SHEET

Field Personnel

D. Purington

M. Swenson

Job No. 19943-002

Location Earth City, MO

Well No. MW-104

Date April 17, 1990

Total Well Depth (from top of casing) 19.9 feet

Depth to Water Surface (from top of casing) 12.27 feet

Height of Water Column 7.63 feet

Volume of Water Column (height x 0.163) 1.24 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	Micromhos	°F	standard units
1	1245	60.6	6.89
2	1202	58.7	7.00
3	1203	56.3	7.03
4	1205	57.1	7.06
5	1222	57.0	6.95
6			
7			
8			

MONITORING WELL FIELD DATA SHEET

Field Personnel
D. Purington
J. Peck

Job No. 19943-002
Location East City, MO
Well No. MW-105
Date April 16, 1990

Total Well Depth (from top of casing) 17.3 feet

Depth to Water Surface (from top of casing) 10.25 feet

Height of Water Column 7.05 feet

Volume of Water Column (height x 0.163) 1.15 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	micromhos	°F	standard units
1	885	56.7	6.74
2	1397	56.0	6.76
3	1304	56.5	6.83
4	1276	56.4	6.78
5	1207	55.7	6.82
6	1212	56.0	6.84
7	1228	55.7	6.80
8			

MONITORING WELL FIELD DATA SHEET

Field Personnel

D. Purington

J. Peck

Job No. 19943-002

Location East City, Mo

Well No. MW-106

Date April 16, 1990

Total Well Depth (from top of casing) 17.3 feet

Depth to Water Surface (from top of casing) 9.58 feet

Height of Water Column 7.72 feet

Volume of Water Column (height x 0.163) 1.25 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	Micromhos	°F	standard units
1	1153	52.4	6.67
2	1186	52.1	6.60
3	1222	52.2	6.60
4	1237	52.2	6.62
5	1225	52.2	6.61
6			
7			
8			

MONITORING WELL FIELD DATA SHEET

Field Personnel
D. Purington
J. Peck

Job No. 19943-002
Location East City, MO
Well No. MW-107
Date April 16, 1990

Total Well Depth (from top of casing) 17.3 feet

Depth to Water Surface (from top of casing) 5.22 feet

Height of Water Column 12.08 feet

Volume of Water Column (height x 0.163) 1.97 gallons

Well Volumes Purged	Specific Conductance	Temperature	pH
Units	Micromhos	°F	standard units
1	1006	53.3	7.14
2	989	51.3	7.0
3	987	50.9	6.96
4	975	50.8	6.93
5			
6			
7			
8			

Briefing re WL Lake File
Oct 8
2:00 PM

MISSOURI DEPARTMENT OF NATURAL RESOURCES
P.O. Box 1368 2010 Missouri Blvd. Jefferson City, Missouri 65102 (314)751-3241

MEMORANDUM

OCT 3 1980

SOLID WASTE MANAGEMENT PROGRAM

Date: October 2, 1980

To: Bob Schreiber

From: Burt McCullough

Subject: Westlake Landfill

Westlake Landfill, located in Bridgeton Missouri (St. Louis County) has been the subject of recent inquiry. This landfill began operation prior to state regulation. As far as our records show, this landfill first opened in the mid-1960's. Part of the landfill lies in an old quarry and part of the landfill lies in the Missouri River floodplain, approximately 1½ miles from the river. Witnesses to this operation, when the area of the landfill which lies in the floodplain was in operation, note that the fill area was often actually beneath the level of the water table. According to file materials from Missouri Geological Survey, it is "highly probable that leachate from the landfill is entering the waters of the Missouri River. . . " Leachate from the old quarry area of the landfill is collected and hauled to MSD treatment plants. Construction of onsite treatment facilities is underway. About 48,000 gallons of leachate per day is currently being collected.

Aside from normal landfill materials, there are chemical industrial wastes and radiologically contaminated materials deposited in this landfill. The chemical wastes, that we know of, include about 4,000 tons of residues from the production of insecticides and herbicides. These pesticide wastes were deposited by Chevron Chemical Company. Also included in the chemical wastes are waste materials from ink manufacture and from the manufacture of glue. Among the chemical wastes that we know of in Westlake Landfill are:

waste ink	pigments	oily sludges
esters	alcohols	insecticides
halogenated intermediates		aromatics
oils	wastewater sludges	
heavy metals	asbestos	herbidices

Besides chemical hazardous wastes, in Westlake Landfill, there are radioactive wastes. During early 1973 Cotter Corporation buried radioactive Barium Sulfate Slag material and radiologically contaminated building ~~rubble~~. There are approximately 9,000 tons of this material which contain about 7 ~~,000~~ tons of natural Uranium. In October, 1977, an aerial radiological survey was done to determine the location of the burial of this contaminated material. The report from this survey indicates that there are two burial sites. One is in the center of the old quarry area, and the other is on the edge of the floodplain area which borders adjacent farmland. The U.S Nuclear Regulatory Commission has contracted Radiation Management Corporation to do extensive on-site radiological surveys which include groundwater analysis, core sampling, test boring, and other tests as deemed necessary. The NRC has given DNR verbal

WLQ0024
Exhibit 20-B

permission to utilize the monitoring wells which Radiation Management Corporation will be digging, in order that DNR may test for the presence of chemical hazardous wastes.

There is little known about what went into Westlake Landfill prior to State regulation. Analysis needs to be done to determine: 1) what wastes are deposited in Westlake Landfill, 2) if any of these pollutants are leaving the landfill via groundwater, and 3) what threat does Westlake Landfill pose to drinking water supplies.

cc: Fred Lafser
Ron Kucera
Jim Long
Robert Robinson
Bob Miller
Tom Doan

nickman

RECEIVED
NOV 2 1977
BUREAU OF
SOLID WASTE MANAGEMENT

3.600 St. Louis County
West Lake Demolition Landfill

October 31, 1977

Mr. William Canney
West Lake Landfill, Inc.
Rt. 1, Box 206
Bridgeton, MO 63044

Dear Mr. Canney:

This is to follow up on the inspection of the West Lake Demolition Landfill on October 4, 1977, by a representative of the Missouri Department of Natural Resources. As a result of this inspection, the following unsatisfactory features are noted and recommendations for their correction are given.

UNSATISFACTORY FEATURES:

1. Non-demolition landfill waste including wastes not even acceptable at sanitary landfills were being deposited at the demolition landfill site.

2. Routine techniques of spreading and compacting the demolitions wastes were not being practiced.

COMMENTS AND RECOMMENDATIONS:

1. A considerable amount of paint sludge in 55 gallon metal drums had been disposed of on the site. It appeared that the majority of the paint sludge had been mixed with soil and had caused one area to be very odorous and extremely damp. Neither the demolition or sanitary landfill should be accepting any quantity of paint or other sludges. It is understood that a small amount might get into the landfill undetected but, it was obvious that a good portion of the sludge could and should have been turned away. Immediate steps must be taken to stop all incoming deposits of such materials and to immediately remove such materials when they some how are dumped. (Section 80-4.010 (2) (A) of the Missouri Solid Waste Rules and Regulations lists the types of materials to be accepted at a demolition landfill. Enclosed is one copy of the Rules and Regulations.

WLQ 0025
Exhibit 20-C

3.600 St. Louis County
West Lake Demolition Landfill

October 28, 1977

2. Acceptance of non-demotion wastes has been observed in the past at the demolition landfill site. It is felt that it is a combination of an inadequate sign listing the wastes to be accepted, inadequate inspection of loads coming in and a willingness to accept such non-demolition materials when they are on site. Section 80-4.010 (2) (C) 2 requires that a list of wastes to be accepted be displayed prominently at all site entrances. No sign was observed at either entrance for the demolition landfill. A sign listing the waste to be accepted must be erected at all entrances to the demolition landfill. A responsible supervisor should be located on site who is willing to thoroughly inspect every load that comes in and to reject all non-demolition materials. Anyone caught dumping non-demolition wastes should be forced to remove such wastes to a proper disposal facility. The combination of advising prospective dumpers of what wastes are accepted via the landfill sign along with a responsible supervisor who is knowledgable about what wastes can and cannot be accepted should result in a great reduction in non-demolition wastes being dumped at the demolition landfill.

3. It was observed that the demolition materials were being dumped at the top of the working face of the landfill and for the most part simply pushed over the edge of the face. Very little compaction was being accomplished. It was understood that some bulky wastes such as large concrete blocks and tree trunks cannot be compacted but, the majority of the other demolition wastes can be spread and compacted in layers around two feet thick on or near a 3 to 1 slope. If possible, it is recommended that the demolition wastes be dumped at the base of working face. Whether the wastes are dumped at the top or base of the working face, every effort must be made to spread and compact the demolition wastes in layers not to exceed two (2) feet as much as practical from the standpoint of the size and shape of the materials. If a load is observed containing large materials that could hinder the proper compaction of other demolition wastes, it should be dumped where it can be more easily handled instead of with the other wastes. Section 80-4.010 (12) (C) 1 requires that solid waste handling equipment shall be capable of :

   1. Spreading and compacting the solid wastes accepted in layers no more than two feet thick, when practical from size and shape of the waste material, while confining it to the smallest practical area.

   2. Compact the solid waste to the smallest practical volume.

   3. Place, spread and compact the cover material as much as practical.

4. An extensive salvage operation was being run at the demolition

3.600 St. Louis County
West Lake Demolition Landfill
Page Three

October 31, 1977

landfill mainly for the collection of metallic objects. It was understood that the salvaged materials are hopefully removed from the site the same day they are collected. The landfill must be commended for the extensive salvage operation but, every effort must be made to remove the salvaged material daily or to keep them neatly stored on site.

5. It was observed that the required twelve (12) inches of weekly cover material had been applied and had been properly compacted any areas that have been brought up to final grade should contain final cover consisting of at least two feet of compacted soil and be properly seeded.

If you have any questions concerning the above comments and recommendations, please feel free to give us a call at our St. Louis Office. Reinspections will be made to insure that any non-demolition materials are not being accepted and the materials accepted are being properly compacted.

APPROVED:	SUBMITTED BY:
Earl F. Holtgraewe	Bud Stein by EFH
Earl F. Holtgraewe, P.E.	Bud Stein
Regional Administrator	Environmental Engineer I
St. Louis REgional Office	St. Louis Regional Office
Department of Natural Resource	Department of Natural Resources

EFH/BS/lb

CC: Earl Breadon
2337 Telegraph Road
St. Louis, MO
St. Louis County Health Department
CO,SW

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL QUALITY

DEMOLITION LANDFILL SURVEILLANCE RECORD

Date: 10-4-77 Days/Week Open: 6

Name of Demolition Landfill: West Lake Landfill, Inc. Demolition Landfill

Permit No: 218903 County: St. Louis County

Owner: West Lake Inc. Operator: Same as owner

Address: Route 1, Box 206 Address:
Bridgeton, Mo 63044

I. Special Conditions and Approved Modifications

A. Are there any special conditions or approved modifications of the satisfactory compliance subsections of the rules and regulations? (e.g. impermeable barrier, limited excavation, exceptions to weekly cover requirements)

_____ Yes __X__ No

B. Is the demolition landfill operation in compliance with the special conditions or approved modifications? (If "No," describe violations under "REMARKS.")

_____ Yes _____ No

II. Check Types of Waste Accepted

	INDICATED ON PERMIT APPLICATION	REPORTED BY OPERATOR	AS OBSERVED
Demolition and construction waste			X
Brush and untreated wood waste			X
Tires			X
Inert Plastics			
OTHER WASTES (SPECIFY) paint sludge, cardboard waste			X

III. Remaining Life of Landfill

A. Estimated average volume of compacted solid waste received.
_____ (tons, yards/day, week) unknown

B. Estimated volume of remaining landfill covered by approved engineering plans.
_____ acre feet

15.058 — 11/76

WLLFOIA4312 - 015 - 0172995

IV. Satisfactory Compliance Subsections Regulations 80-4.010
Check all sul :tions: SAT — Satisfactory; UNS — Unsatisfactory. (If necessa escribe "UNS" violations under "Remarks.")

...TION ...BER	SATISFACTORY COMPLIANCE OPERATING PROCEDURE	SAT	UNS
SOLID WASTE ACCEPTED			
	Routine sanitary landfill techniques of spreading and compacting solid waste shall be used as much as practicable to dispose of solid waste in a demolition landfill.		X
	A list of wastes to be accepted shall be displayed prominently at the site entrance.		X
...ID WASTE EXCLUDED			
1	A responsible supervisor shall be present at the disposal area at all times when the area is open to receive waste.	X	
	Excluded wastes deposited removed to an approved disposal site.		X
...ITE SELECTION			
	Site accessible by all-weather roads.	X	
...ER QUALITY			
1	Surface water courses and runoff satisfactorily diverted from the landfill. Demolition landfill construction and grading to promote rapid surface water runoff without excessive erosion.	X	
	Decomposable solid wastes deposited above predicted maximum water table.	X	
...QUALITY			
	No open burning without written permission from the agency having jurisdiction.	X	
...AS CONTROL			
	Decomposition gases adequately vented to prevent danger to occupants of adjacent property.	X	
	Gases vented to prohibit explosive or toxic accumulations.	X	
...ORS			
	Vector control programs implemented when necessary.	X	
...STHETICS			
	Litter collected and compacted into cell be utilized daily.	X	
	Wastes easily moved by wind covered as necessary.	X	
3	On-site vegetation and natural windbreaks being utilized for litter control and aesthetic appearance.	✓	

SUBSECTION NUMBER	SATISFACTORY COMPLIANCE OPERATING PROCEDURE	SAT	UNS
(10) AESTHETICS (continued)			
(10)(C)4	Salvaged materials removed daily or stored in aesthetically acceptable manner. could be better	X	
(11) COVER MATERIAL			
(11)(C)1	Twelve (12) inches compacted soil cover material applied at least once every seven calendar days.	X	
(11)(C)2	Final cover of at least two (2) feet compacted soil applied on all completed areas.	X	
(12) COMPACTION			
(12)(C)1A	Solid waste spread in layers not to exceed two (2) feet as much as practical.		X
(12)(C)1B	Solid waste compacted to smallest practical volume.		X
(12)(C)1C	Cover material compacted as much as practical.	X	
(12)(C)2	Equipment available and operated to spread and compact the solid waste as received or at least when the accumulated waste reaches 200 cubic yards.		X
(12)(C)3	No solid waste disposed of in water where the water interfered with spreading and compacting or where the water is causing a mosquito problem.	X	
(13) SAFETY			
(13)(C)1	Fire extinguishers provided on all equipment.	—	—
(13)(C)2	Provisions for extinguishing fires in waste, equipment or structures.	—	—
(13)(C)3	Scavenging prohibited.	X	
(13)(C)4	Controlled access limited to operating hours.	X	
(13)(C)5	Traffic control signs provided.	X	
(13)(C)6	Dust control adequate.	X	
(14) RECORDS			
(14)(C)1A	Records of complaints and major problems.	—	—
(14)(C)1B	Records of dates of cover material application.	—	—
(14)(C)1C	Records of vector control efforts.	—	—
(14)(C)1D	Records of dust and litter control efforts.	—	—
(14)(C)1E	Records of quantity of waste received.	—	—
(14)(C)2	Records of location of general types of wastes and depth of fill.	—	—

V. Operation Proceeding in Accordance With Approved Engineer Plans? (If "No," describe violations under "Remarks.")

X Yes ______ No

REMARKS Paint sludges being disposed in vicinity of demolition landfill; dumping at top, pushing over edge, cliff method, therefore poor compaction; they need better sign and better control of materials coming in; extensive salvage operation; apparently salvaged materials hauled daily.

(Attach additional sheets as necessary.)

BY Bud Stein
SIGNATURE OF INVESTIGATOR

1

TABLE I - Results of Analysis of Leachate From Westlake Landfill, Incorporated (1/23/78)

	PARAMETER	CONCENTRATION
1.	pH (Std. Units)	6.0
2.	Specific Conductance (µmhos/cm)	3170
3.	Alkalinity as $CaCO_3$ (mg/l)	475
4.	Acidity as $CaCO_3$ (mg/l)	415
5.	Total Solids (mg/l)	4030
6.	Suspended Solids (mg/l)	392
7.	Volatile Suspended Solids (mg/l)	223
8.	Grease (mg/l)	56
9.	Chemical Oxygen Demand (mg/l)	3820
10.	Total Organic Carbon (mg/l)	1090
11.	Phenol (mg/l)	1.02
12.	Fluoride (mg/l)	0.5
13.	Chloride (mg/l)	330
14.	Cyanide (mg/l)	<0.1
15.	Kjeldahl Nitrogen as N (mg/l)	83.2
16.	Sulfate (mg/l)	580
17.	Sulfide (mg/l)	<0.1
18.	Surfactant (MBAS) (mg/l)	0.5
19.	Chromium (mg/l)	<0.5
20.	Copper (mg/l)	1.60
21.	Iron (mg/l)	31.0
22.	Lead (mg/l)	<0.5
23.	Nickel (mg/l)	<0.3
24.	Zinc (mg/l)	10.8

Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri

January 1, 1987

Annual Report

MISSOURI
DEPARTMENT OF NATURAL RESOURCES
Division of Environmental Quality

WQM C026
Exhibit 20-D

WESTLAKE LANDFILL

Classification: Class II, Priority 2

Site Name: Westlake Landfill

Address: Bridgeton, MO 63042. Between Old Rock Hill Road and New Rock Hill Road east of Earth City
T 46 N, R 5 E, St. Charles Quadrangle

Waste Type: Organics, inorganics, solvents, pesticides, heavy metals, acids, bases, plating wastes and radionuclides
Quantity: Unknown

Site Description:

The site is an active landfill on the Missouri River floodplain in St. Louis County. The site has been reduced to two areas (see attached legal description).

Present Owner: William McCullough, President, Westlake Landfill, Inc., Bridgeton, MO 63042

Environmental Problems Related to Site:

The site is an active permitted landfill which in the past accepted unknown quantities of hazardous wastes. Excavation at the site in the past reached the same depth as the groundwater. Unknown quantities of hazardous materials have been deposited in direct contact with groundwater. There is potential for contamination of groundwater and the Missouri River which is less than one mile away, directly west of the site.

Remedial Actions at Site:

The site was surveyed prior to expansion in order to separate the demolition fill area from the area identified as containing hazardous materials.

Area of Concern Related to Site:

The average natural ground elevation is 435 to 440 feet with groundwater at a shallow depth. The alluvium underlying the river is one of the most important aquifers in the state. Consequently, if contamination is occuring from the landfill, it is threatening a vital aquifer resource.

General Geologic and Hydrologic Setting:

LOCATION: Longitude 90 26' 45"; latitude 38 46' 15", St. Charles Quadrangle.

The landfill has been in existance for more than twenty years. For most of that time period, landfilling has occurred on the Missouri River floodplain. Landfilling also has taken place in a limestone quarry adjoining the floodplain landfill. The quarry is in the St. Louis Limestone which is present along the eastern slopes of the Missouri River floodplain.

The early portion of the landfill operation included excavation and filling below the floodplain and into the groundwater of the Missouri River aquifer. Subsequent landfill operations generally were confined to filling above the floodplain surface and also in the adjoining limestone quarry. Except where operational procedures cause outbreaks of leachate to occur in the quarry or runoff water to drain into the quarry, there was no evidence of significant amounts of groundwater from the alluvial aquifer entering the limestone. For the most part, the recharge, quite limited to begin with, would be from the bedrock adjoining the alluvium into the Missouri River aquifer rather than the aquifer recharging the surrounding bedrock.

Groundwater monitoring indicates contaminant movement into the alluvial aquifer in a generally northwesterly direction. However, such monitoring to date is inadequate to verify this indication or to adequately characterize the nature of the alluvial aquifer in the vicinity of the landfill.

The Missouri River floodplain sediments consist of 15 to 20 feet of silt loam to very silty clay having moderate to high permeability. The groundwater table occurs at depths of 15 to 20 feet below floodplain level. Fluctuations of 5 to 15 feet occur during periods of high water levels when there are prolonged wet seasons that affect the Missouri River. Local wet or dry periods cause little effect other than recharge directly through the landfill. This may be the most significant risk posed by the Westlake Landfill, the poor soil covering procedures that apparently occurred during landfill operation.

Beneath the silt loam, very silty clay surface soil of the alluvium, the Missouri River alluvial sediments are characterized by a general increase in grain size associated with increasing depth. The sand increase becomes noticeable at depths of 20 to 30 feet with the percentage of gravel beginning to occur at depths of 30 to 40 feet. These coarse sediments, plus the large and perennial recharge of the river, cause the alluvium to be one of the major and most important aquifers in the state. Consequently, if contamination is occurring from the landfill, it is threatening a vital aquifer resource.

Public Drinking Water Advisory:

There are no public water systems located in the immediate vicinity of Westlake Landfill. However, the site is less than one mile from the Missouri River, which is the water source for St. Louis County Water Company's North Plant. The intake for that plant is about eight miles downstream from Westlake Landfill. Should contamination from the site reach the Missouri River, the downstream public water system could be affected.

Private wells located near the landfill may also be susceptible to contamination.

Health Assessment:

The Westlake Landfill site has been found to be contaminated with 4000 tons of chlordane, trichloroethylene and toluene, and 7000 tons of low level uranium ore wastes.

Chlordane is a broad spectrum insecticide that has been observed to cause the following symptoms: blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors, convulsions, anuria, and cancer in laboratory animals. It attacks the central nervous system, eyes, lungs, liver, kidneys, and skin. TCE or trichloroethylene is an animal carcinogen and is also capable of causing the following symptoms: irritation of the eyes, nose and throat; dermatitis; headache, dizziness, vertigo, tremors, nausea and vomiting, irregular heartbeat, sleepiness, fatigue, blurred vision, unconsciousness, and death. Damage occurs to the respiratory system, heart, liver, kidneys, and central nervous system. Toluene has been observed to cause irritation of the eyes, respiratory tract, and skin; dermatitis, headache, dizziness, fatigue, muscular weakness, drowsiness, lack of coordination, staggering gait, skin paresthesia, collapse and coma.

Uranium is reported to cause adverse health effects in two ways: toxic chemical effects including damage to the kidney and liver, pneumoconiosis, pronounced changes in the blood and generalized injury; and radiation effects including lung cancer, osteosarcoma, and lymphoma.

Analysis of the rates of fetal death, low birth weight, and malformations for 1972-1982 showed no rate for the area significantly higher than the state average.

A well survey and water sampling has been completed, and an exposure questionnaire is presently being administered to selected residents near the site. This investigation by the Missouri Department of Health has found there are only four wells still in use in the area that are downgradient from the site. One is used only occasionally and one is not used for potable water at all. None of the wells sampled had detectable amounts of any of the chemicals disposed of at the site. None of the residents questioned so far appeared to have any adverse health effects caused by materials disposed of at the site.

Based on available information, a health threat exists due to the toxic effects of chemicals and low level uranium wastes buried at the site, and the possibility that off-site migration of these materials might occur. While there is no evidence of past or present exposure, the potential for future exposure exists based on the possibility that off-site migration might occur. Sampling and corrective containment and diversion should continue at this site until risk to the public health can more accurately be determined.

Confirmed Abandoned or Uncontrolled Hazardous Waste Disposal Sites in Missouri

Fiscal Year 1987
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MISSOURI
DEPARTMENT OF NATURAL RESOURCES
Division of Environmental Quality

Exhibit 20-E

WESTLAKE LANDFILL

Classification: Class III, Priority 14

Site Name: Westlake Landfill

Address: Bridgeton, MO 63042. Between Old Rock Hill Road and New Rock Hill Road east of Earth City, St. Louis County T 46 N, R 5 E, St. Charles Quadrangle

Waste Type: radionuclides

Quantity: 7000 tons of low level uranium ore wastes

Site Description:

The site is part of an active landfill on the Missouri River floodplain in St. Louis County.

Present Owner: Westlake Landfill, Inc.,
Bridgeton, MO 63042

Environmental Problems Related to Site:

The site is an active permitted landfill which in the past accepted 7000 tons of low level uranium ore wastes. Excavation at the site in the past reached the same depth as the groundwater. There is potential for contamination of groundwater and the Missouri River which is less than one mile away, directly west of the site.

Remedial Actions at Site:

The site was surveyed prior to expansion in order to separate the demolition fill area from the area identified as containing hazardous materials.

The Missouri Department of Natural Resources is the lead agency for this site.

Area of Concern Related to Site:

The average natural ground elevation is 435 to 440 feet with groundwater at a shallow depth. The alluvium underlying the river is one of the most important aquifers in the state. Consequently, if contamination is occuring from the landfill, it is threatening a vital aquifer resource.

General Geologic and Hydrologic Setting:

LOCATION: Longitude 90 26' 45"; latitude 38 46' 15", St. Charles Quadrangle.

The landfill has been in existence for more than twenty years. For most of that time period, landfilling has occurred on the Missouri River floodplain. Landfilling also has taken place in a limestone quarry adjoining the floodplain landfill. The quarry is in the St. Louis Limestone which is present along the eastern slopes of the Missouri River floodplain.

The early portion of the landfill operation included excavation and filling below the floodplain and into the groundwater of the Missouri River aquifer. Subsequent landfill operations generally were confined to filling above the floodplain surface and also in the adjoining limestone quarry. Except where operational procedures cause outbreaks of leachate to occur in the quarry or runoff water to drain into the quarry, there was no evidence of significant amounts of groundwater from the alluvial aquifer entering the limestone. For the most part, the recharge, quite limited to begin with, would be from the bedrock adjoining the alluvium into the Missouri River aquifer rather than the aquifer recharging the surrounding bedrock. Near the bedrock quarry pit, however, the potential exists for draining some alluvial water into this sump. Apparently, the pit is dewatered on a continuous basis with the water pumped to discharge in the alluvial setting. Groundwater monitoring indicates general movement of the alluvial groundwater to the west and north.

The Missouri River floodplain sediments consist of 15 to 20 feet of silt loam to very silty clay having moderate to high permeability. The groundwater table occurs at depths of 15 to 20 feet below floodplain level. Fluctuations of 5 to 15 feet occur during periods of high water levels when there are prolonged wet seasons that affect the Missouri River. Local wet or dry periods cause little effect other than recharge directly through the landfill. This may be the most significant risk posed by the Westlake Landfill, the poor soil covering procedures that apparently occurred during landfill operation.

Beneath the silt loam, very silty clay surface soil of the alluvium, the Missouri River alluvial sediments are characterized by a general increase in grain size associated with increasing depth. The sand increase becomes noticeable at depths of 20 to 30 feet with the percentage of gravel beginning to occur at depths of 30 to 40 feet. These coarse sediments, plus the large and perennial recharge of the river, cause the alluvium to be one of the major and most important aquifers in the state. Consequently, if contamination is occurring from the landfill, it is threatening a vital aquifer resource.

<u>Public Drinking Water Advisory</u>:

There are no public water systems located in the immediate vicinity of Westlake Landfill. However, the site is less than one mile from the Missouri River, which is the water source for St. Louis County Water Company's North Plant. The intake for that plant is about eight miles downstream from Westlake Landfill. Should contamination from the site reach the Missouri River, the downstream public water system could be affected.

Private wells located near the landfill may also be susceptible to contamination.

Health Assessment:

Uranium is reported to cause adverse health effects in two ways: toxic chemical effects including damage to the kidney and liver, pneumoconiosis, pronounced changes in the blood and generalized injury; and radiation effects including lung cancer, osteosarcoma, and lymphoma.

Analysis of the rates of fetal death, low birth weight, and malformations for 1972-1982 showed no rate for the area significantly higher than the state average.

An exposure assessment including a well survey, water sampling, and an administrative exposure questionnaire was completed for the site. This investigation by the Missouri Department of Health has found there are only four wells still in use in the area that are downgradient from the site. One is used only occasionally and one is not used for potable water at all. None of the residents questioned appeared to have any adverse health effects caused by materials disposed of at the site.

Based on available information, a health threat exists due to the effects of low level uranium wastes buried at the site, and the possibility that off-site migration of these materials might occur. While there is no evidence of past or present exposure, the potential for future exposure exists based on the possibility that off-site migration might occur. Sampling and corrective containment and diversion should continue at this site until risk to the public health can more accurately be determined.

NOV 17 1980

ORIGIN OF MATERIAL AND HISTORY OF LICENSE

1942-1966	BELGIN CONGO AND DOMESTIC URANIUM ORES PROCESSED AT MALLINCKRODT, INCORPORATED, AT DESTREHAN STREET FACILITY ON NORTH SIDE OF ST. LOUIS. AGREEMENT WITH U. S. , BELGIANS WANTED ORE RESIDUES (DAUGHTERS) RETURNED. MATERIAL WAS HELD BY U. S., BUT NOT CLAIMED BY BELGIAN CONGO.
JANUARY 10, 1964	AEC-OAK RIDGE OPERATIONS OFFICE PUT OUT BID PACKAGE TO SELL, AS LISTED IN BID PACKAGE, TOTAL ORE RESIDUES OF 117,050 TONS OF RAFFINATE OR BARIUM SULFATE CAKE CONTAINING APPROXIMATELY 191 TONS OF URANIUM. THE 8700 TONS OF $BaSO_4$ (LEACHED) CONTAINING 7 TONS OF URANIUM WAS ITEMIZED AS PART OF THIS PACKAGE.
EARLY 1966	CONTINENTAL MINING AND MILLING COMPANY, CHICAGO, ILLINOIS, LICENSE NO. SMA-862 PURCHASED FROM AEC-ORO. THE ORE RESIDUES WERE STORED AT ST. LOUIS AIRPORT. ORE RESIDUES WERE MOVED TO 9200 LATTY AVENUE, HAZELWOOD, MISSOURI.
DECEMBER 29, 1966	LICENSE NO. SMC-907 WAS ISSUED TO COMMERCIAL DISCOUNT CORPORATION, CHICAGO, ILLINOIS ALLOWING FOR POSSESSION OF RESIDUES, REMOVAL OF MOISTURE, AND SHIPMENT TO COTTER CORPORATION IN CANON CITY, COLORADO.
J' ARY 1967	CONTINENTAL MINING AND MILLING TERMINATED BUSINESS, COMMERCIAL DISCOUNT CORPORATION OF CHICAGO, ILLINOIS, TOOK PHYSICAL POSSESSION OF THE FACILITIES AND SOURCE MATERIAL STOCKPILE.

WQM0067

Exhibit 23-A

DECEMBER 31, 1969	COTTER CORPORATION, CANON CITY, COLORADO, LICENSE NO. SUB-1022 PURCHASED REMAINING SOURCE MATERIAL AT LATTY AVENUE.
AUGUST TO OCTOBER 1973	COTTER TRANSPORTED FROM THE LATTY AVENUE SITE 10,763,41 TONS OF RESIDUE BY RAIL TO CANON CITY, COLORADO. 48,544,70 TONS OF RESIDUE AND SOIL CONTAINING APPROXIMATELY SEVEN TONS OF NATURAL URANIUM WERE TRANSPORTED TO THE WEST LAKE LANDFILL SITE.
APRIL 10, 23, AND 24, 1974	REGION III INSPECTION AT HAZELWOOD, MISSOURI SITE AND CANON CITY, COLORADO OFFICE.
MAY 10, 1974	LICENSEE SUBMITS FINAL SURVEY OF LATTY AVENUE SITE TO AEC LICENSING.
NOVEMBER 1, 1974	FINDINGS OF APRIL, 1974 INSPECTION BY REGION III ARE SENT BY LETTER FROM AEC HEADQUARTERS TO COTTER CORPORATION ADVISING THAT DILUTION AND DISPOSAL OF ORE RESIDUES ARE NOT IN KEEPING WITH INTENT OF PART 20. NO ITEMS OF NONCOMPLIANCE.
NOVEMBER 13, 1974	AEC LICENSING TERMINATED LICENSE NO. SUB-1002.

INSPECTION HISTORY

DATES	LICENSEE	FINDINGS
MAY 16, 17, AND AUGUST 4, 1965	CONTINENTAL MINING & MILLING COMPANY LICENSE NO. SMA-862	5 ITEMS OF NONCOMPLAINCE RE: INADEQUATE POSTING, INADEQUATE SURVEYS & PERMISSIBLE LEVEL OF RADIATION IN UNRESTRICTED AREAS
JANUARY 11, 1967	COMMERCIAL DISCOUNT CORPORATION LICENSE NO. SMC-907	2 ITEMS OF NONCOMPLIANCE RE: PERMISSIBLE LEVELS OF RADIATION IN UNRESTRICTED AREAS AND INADEQUATE POSTING
MARCH 27 AND APRIL 1, 1968	COMMERCIAL DISCOUNT CORPORATION LICENSE NO. SMC-907	2 ITEMS OF NONCOMPLIANCE RE: PERMISSIBLE LEVELS OF RADIATION IN UNRESTRICTED AREAS AND INADEQUATE SURVEYS
NOVEMBER 17, 1970	COTTER CORPORATION LICENSE NO. SUB-1022	ONE ITEM OF NONCOMPLIANCE RE: INADEQUATE SURVEYS
APRIL 10, 23, & 24, 1974	COTTER CORPORATION LICENSE NO. SUB-1022	DISPOSAL OF URANIUM BY DILUTION AND BURIAL ARE NOT IN KEEPING WITH INTENT OF AEC REGULATIONS. NOT CITED AS A NONCOMPLIANCE

CONCLUSIONS OF JUNE 22-24, AUGUST 11, 1976 INVESTIGATION

1. THE REMAINING ORE RESIDUES AT LATTY AVENUE SITE WERE MIXED WITH SOIL TRANSPORTED TO THE WEST LAKE LANDFILL AS REPORTED BY THE LICENSEE DURING THE APRIL, 1974 INSPECTION. HOWEVER, THE RESIDUE-SOIL MIXTURE IS COVERED BY APPROXIMATELY 3 FEET OF FILL AT WEST LAKE LANDFILL INSTEAD OF 100 FEET AS REPORTED BY THE LICENSEE.

2. ENVIRONMENTAL SOIL SAMPLES INDICATE THE PRESENCE OF URANIUM ORE PROCESS RESIDUES REMAINING AT THE LATTY AVENUE SITE. BETA-GAMMA SURVEYS PERFORMED BY RIII PERSONNEL AT THAT SITE ON AUGUST 11, 1976 INDICATE LEVELS OF RADIATION IN CERTAIN AREAS EXCEEDING THE CRITERIA ESTABLISHED BY THE NRC FOR DECONTAMINATION OF LAND AREAS PRIOR TO RELEASE FOR UNRESTRICTED USE.

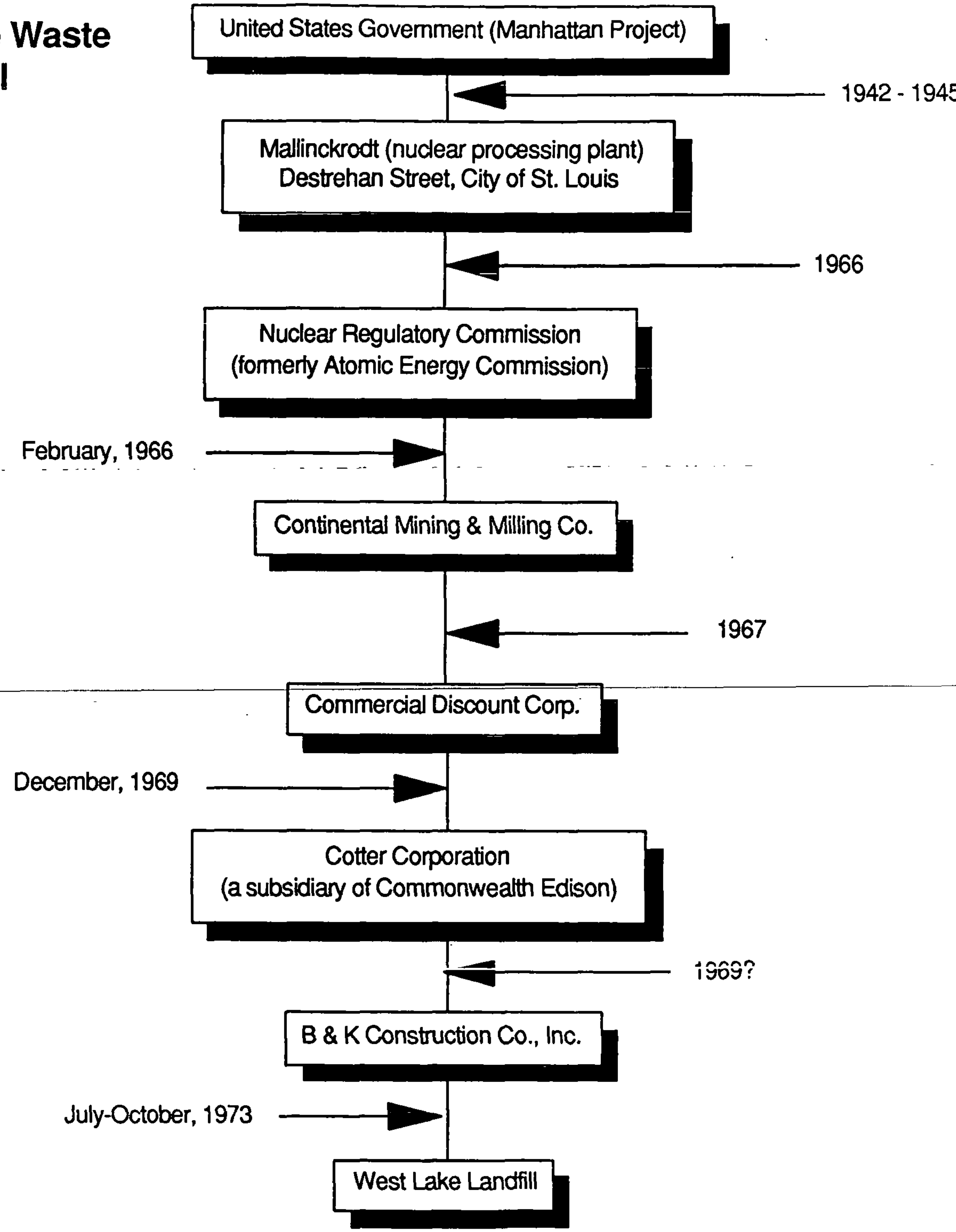
3. BASED ON RADIATION MEASUREMENTS OF THE MATERIAL PRESENT AT THE WEST LAKE LANDFILL AND THE LATTY AVENUE SITE NEITHER LOCATION PRESENTS AN IMMEDIATE RADIOLOGICAL HEALTH HAZARD TO THE PUBLIC.

RECOMMENDATIONS

A MORE DETAILED ENVIRONMENTAL EVALUATION OF THE LATTY AVENUE AND THE WEST LAKE LAND FILL SITES SHOULD BE PERFORMED.

OAK RIDGE NATIONAL LABORATORY TO PERFORM THIS EVALUATION. ANY RECOMMENDATIONS WILL BE BASED ON THE OAK RIDGE EVALUATION.

Chronology of Radioactive Waste at West Lake Landfill



WQM 0028

Exhibit 23-B

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